Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

UNE, 1953 TECHNOLOGY DEPT

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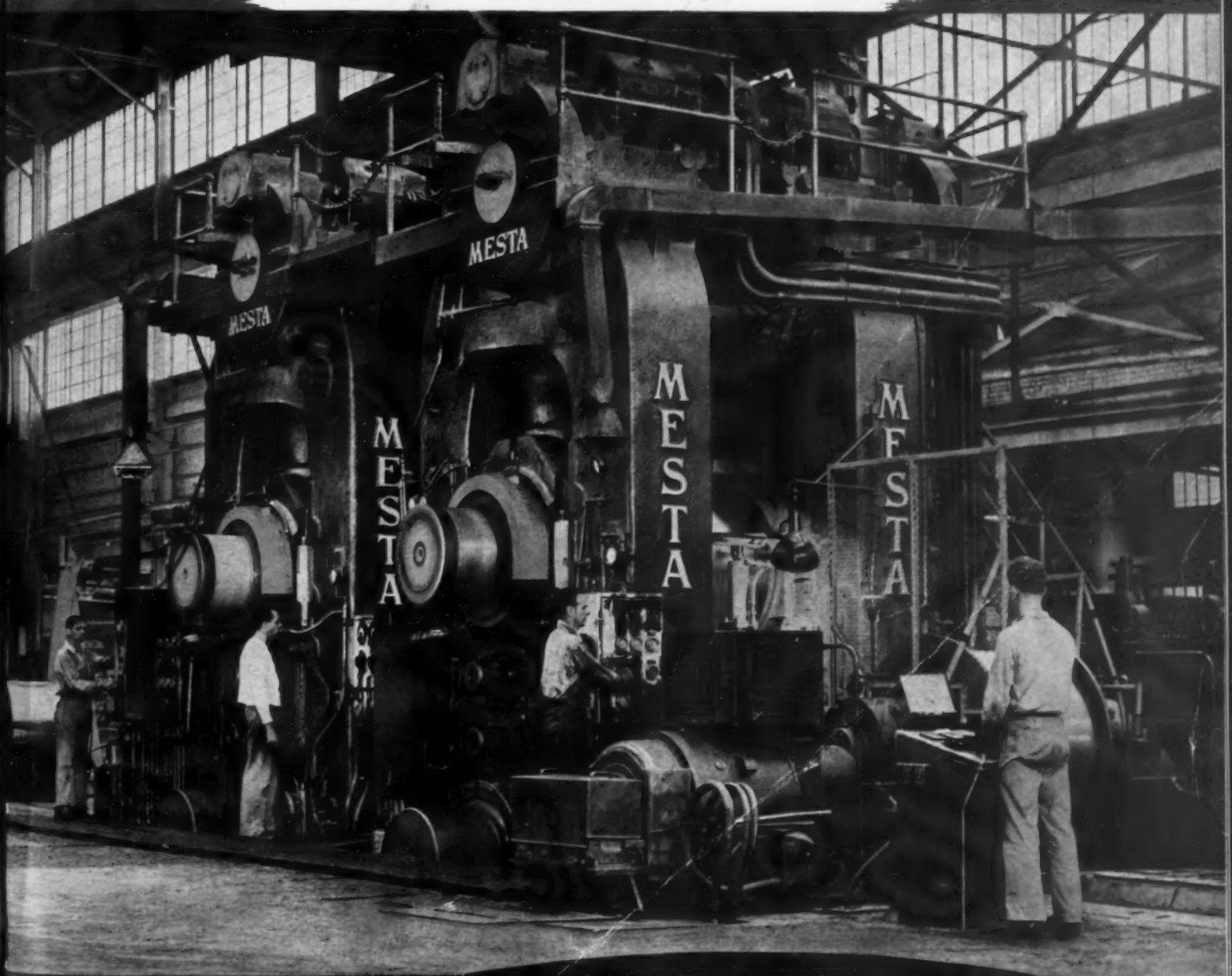
MESTA HIGH-SPEED COLD MILLS



MESTA 42" FOUR-HIGH TWIN-STAND HIGH-SPEED SKIN PASS MILL

Designers and Builders of Complete Steel Plants

MESTA MACHINE COMPANY

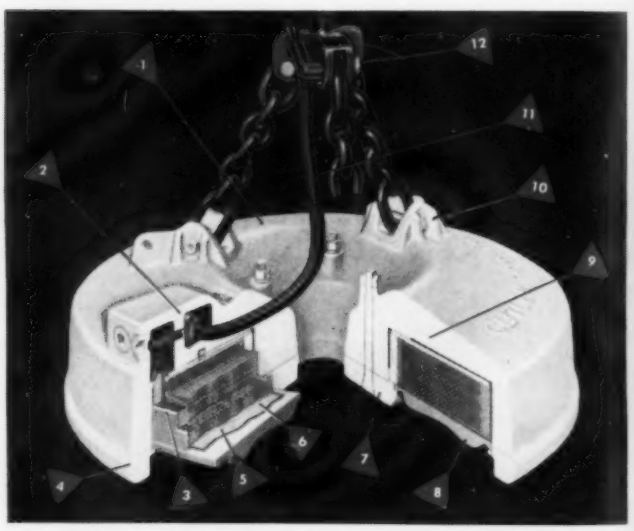
PITTSBURGH, PENNSYLVANIA

INSIDE AND OUT, CUTLER-HAMMER MAGNETS ARE

BUILT TO LIFT BUILT TO LAST

Check any and every feature of Cutler-Hammer Magnet construction and you will find these magnets are built to lift, built to last. From the strap copper windings that give the coils greatest cross-section area of copper to the high permeability steel spool on which the coils are wound, this is true. From the asbestos ribbons, and the bonded mica insulation between the coils, to the heavy dynamo steel body, this is so. From the double-celled moisture-proof terminal box to the engineered yoke design that keeps chains from excessive wearing, this is evident. In every way, Supermagnets are built to lift more each trip, to pick up and discharge loads faster, to maintain capacity and speed all day long and through the long magnet life.

You will find experienced men of the iron and steel industry in full agreement. You *should* have a Cutler-Hammer Supermagnet. CUTLER-HAMMER, Inc., 1257 St. Paul Avenue, Milwaukee 1, Wisconsin.



1. Rugged, cast, high permeability dynamo steel body.

2. Coil connections in water-tight compartment. Leads readily renewed.

4. Tough alloy steel outer pole shoe welded to body.

3, 5 & 6. Strap copper wound coil, asbestos-ribbon insulation between turns, vacuum impregnated with high temperature thermal setting compound. Bonded mica insulating sheets between windings.

7. Bolted inner pole shoe, easily replaceable.

8. Heavy manganese steel shield protects coils from shock.

9. Steel sheathed capsule coil can readily be replaced.

10. Integrally cast suspension lugs stand severe service.

11. Heavy double conductor cable leads protected by heavy hose—with C-H weatherproof connectors.

12. New yoke design keeps chain strands from twisting, reduces wear of links, lengthens chain life.

CUTLER-HAMMER
LIFTING MAGNET
C-H

IRON AND STEEL ENGINEER, published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress, March 3, 1879. $7.50 per year in United States and Canada, $10.00 foreign countries. Volume 30, No. 6.

GOOD EQUIPMENT BRINGS DOWN PRODUCTION COSTS

flat-rolled finishing equipment

Finishing of sheets, strip, plates and other flat-rolled products, requires many different kinds of machines. Much of this equipment is made by Aetna-Standard, such as: High-Speed Shearing and Classifying Lines; Levellers, two high and four high; Hydraulic Stretchers; Pay-Off and Tension Reels; Scrubbing and Drying Lines; Slitting and Side Trimming Lines. Illustrated here is a Multiple Block Tension Reel. When you want specialized assistance on your flat-rolled production, call upon Aetna-Standard. We have flat-rolled specialists available for you.

THE AETNA-STANDARD ENGINEERING COMPANY • PITTSBURGH, PA.

Aetna•Standard

PLANTS IN WARREN, OHIO • ELLWOOD CITY, PENNSYLVANIA

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Head Wrightson Machine Company, Ltd., Middlesbrough, England — Great Britain, Finland, Sweden, Norway, Denmark, Union of South Africa, Southern and Southern Rhodesia.
Aetna-Standard Engineering Company, Ltd., Toronto, Ontario, Canada.
M. Castellvi, Inc., New York, N. Y. — Mexico, Central and South America.
Societe de Constructions de Montbard, Paris, France — France, Belgium, Holland, Luxembourg, Switzerland.
Demag Aktiengesellschaft, Duisburg, Germany — Germany, Austria, Yugoslavia, Greece, Turkey, Egypt.
Compagnia Italiana Forme Acciaio, Milano, Italy — Italy.
Aetna-Japan Company, Ltd., Tokyo, Japan — Japan.
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Designers and Builders to the Ferrous, Non-Ferrous, Leather, Rubber, and Plastic Industries

Grinding the Roll

AN EYE FOR PRECISION

National knows the importance of precision finished rolls. They know that they must meet your specifications so that you in turn can precision-roll sheets, strip and plate to your customer's specifications. National's experience in roll finishing plus the most modern machine tools is your assurance of rolls machined to your requirements. Try us and see.

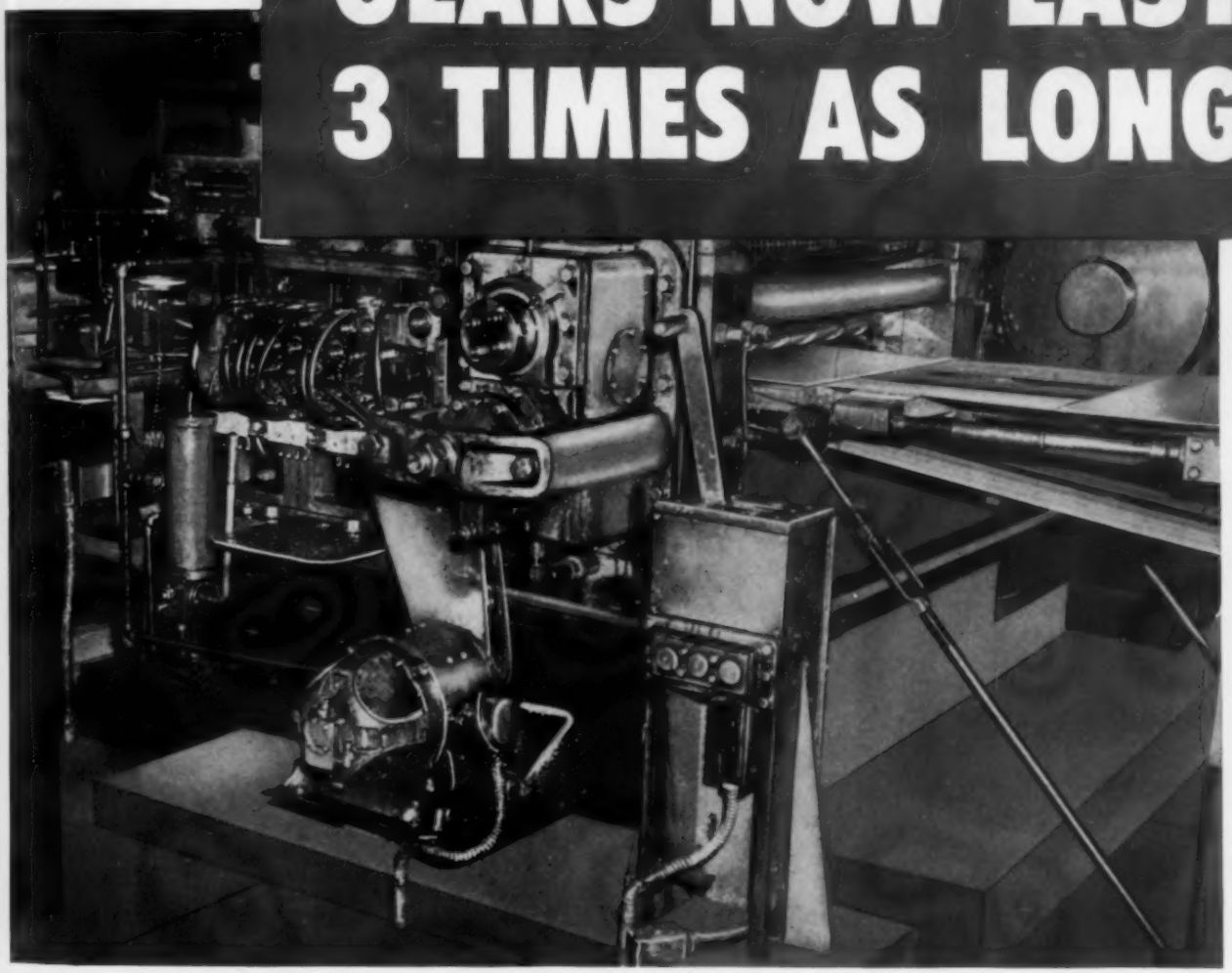
National Rolls

THE NATIONAL ROLL & FOUNDRY CO.

AVONMORE, PENNSYLVANIA

SPECIALISTS IN IRON AND ALLOY IRON ROLLS AND CASTINGS

WEIRTON'S SHEAR GEARS NOW LAST 3 TIMES AS LONG



The Situation: Weirton Steel Company, Weirton, W. Va., was having trouble with the gears of seven Hallden tin plate shears. Gears were pitting badly and running so hot that a continuous vapor rose from the vent. Gear life was only about five months.

The Remedy: A Texaco Lubrication Engineer was called in, asked to study the problem. He recommended *Texaco Meropa Lubricant* and the lubricant on one shear drive was changed over as a test.

The Results: Improvement in performance with *Texaco Meropa Lubricant* was so marked that within six months the other six shears were also changed over. The average life of the gears is now eighteen months.

Wierton's experience typifies the ideal protection *Texaco Meropa Lubricant* affords enclosed gears of every type. The EP properties of *Texaco Meropa Lubricant* are especially long-lasting and are not affected by high operating temperatures. *Texaco Meropa Lubricant* does not separate, thicken or foam. It is not affected by moisture. It is highly resistant to oxidation and non-corrosive to bearings.

Let a Texaco Lubrication Engineer give you all the facts. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

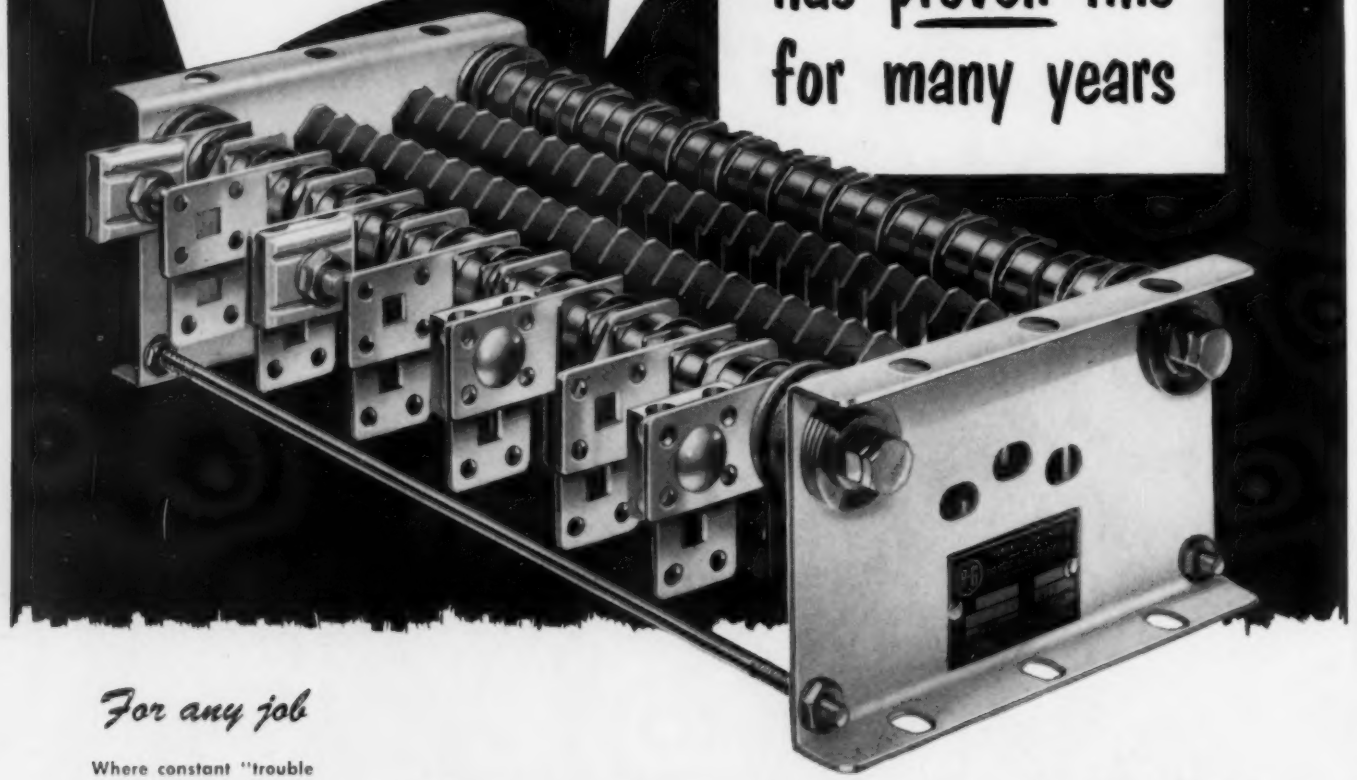
TEXACO

TEXACO Meropa Lubricants

FOR STEEL MILL GEAR DRIVES

There is a *difference* in Resistors

P-G has proven this for many years



For any job

Where constant "trouble free" resistor service is wanted...you can safely specify P-G Steel Grid Resistors and get better performance with low cost maintenance.

Different, because steel and mica, both extremely durable materials, coupled with P-G exclusive design produce a resistor of great mechanical strength. There is nothing to break. With accurate resistance values and adequate carrying capacities, P-G Resistors outlast ordinary resistors. Tell us your specifications and let P-G solve your resistor problem.

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

Holds world's record of 214,842 tons in 31 days... *with help of TIMKEN® bearings*

THIS United Engineering slabbing mill recently set a world's record at U. S. Steel's Homestead plant by producing 214,842 net tons of steel slabs in 31 days. Timken® bearings on the roll necks helped reduce time-outs for repair and maintenance to a minimum, insured long, trouble-free performance.

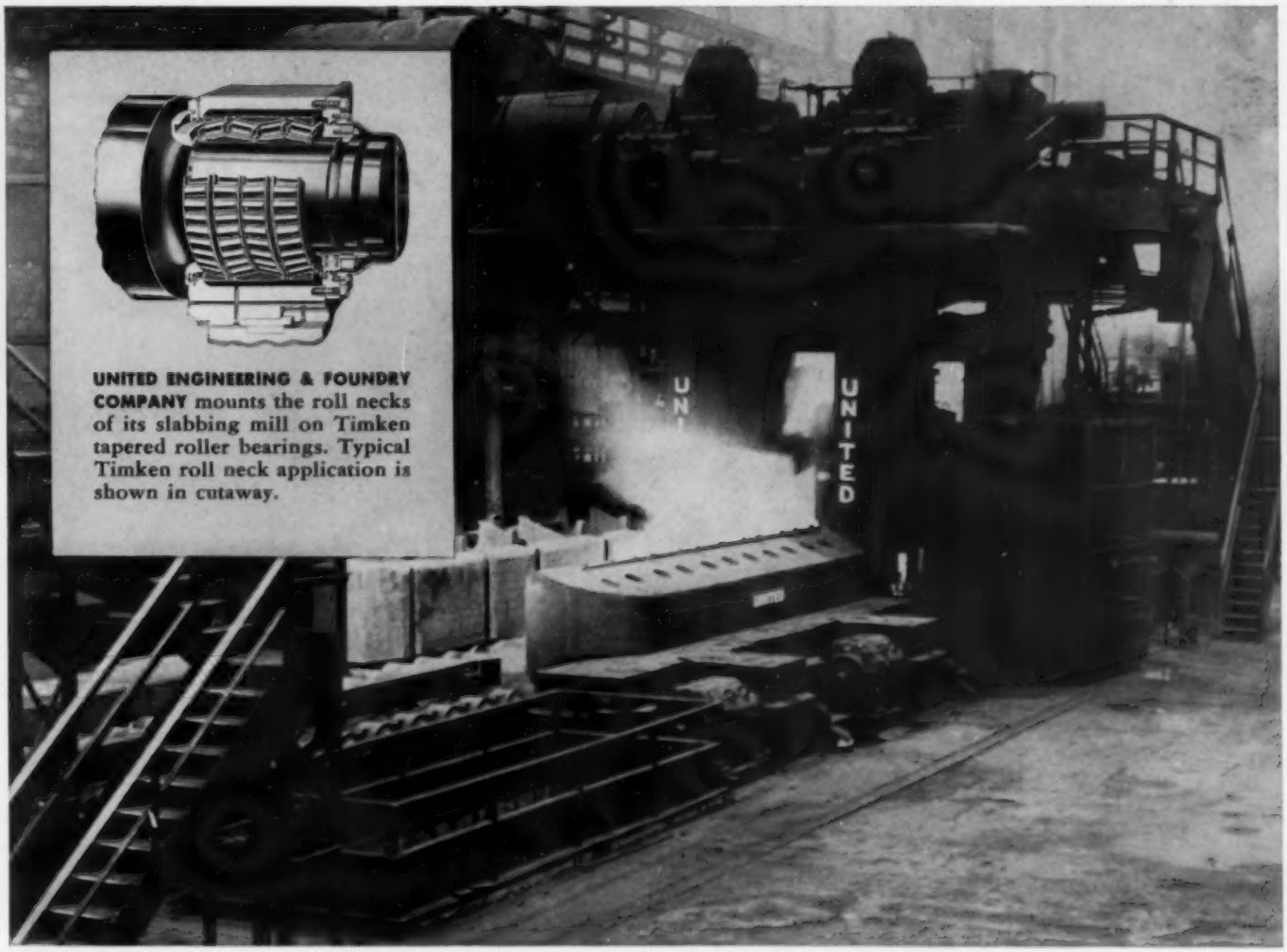
The balanced proportion design of Timken bearings provides maximum bearing capacity in a given space. Load ratings are increased up to 40%, roll neck strength 50 to 60%.

Timken tapered roller bearings give you greater mill rigidity, permit larger diameter roll necks. Costly and complicated lubrication systems are eliminated.

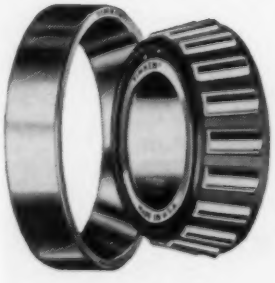
And because they take radial and thrust loads in any combination, no special thrust bearings are needed.

Years of research and development by The Timken Company have resulted in many improvements in roll neck bearing design and performance. For further information write The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

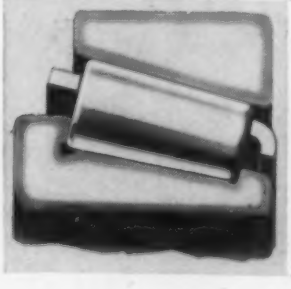
This symbol on a product means its bearings are the best.



UNITED ENGINEERING & FOUNDRY COMPANY mounts the roll necks of its slabbing mill on Timken tapered roller bearings. Typical Timken roll neck application is shown in cutaway.



TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

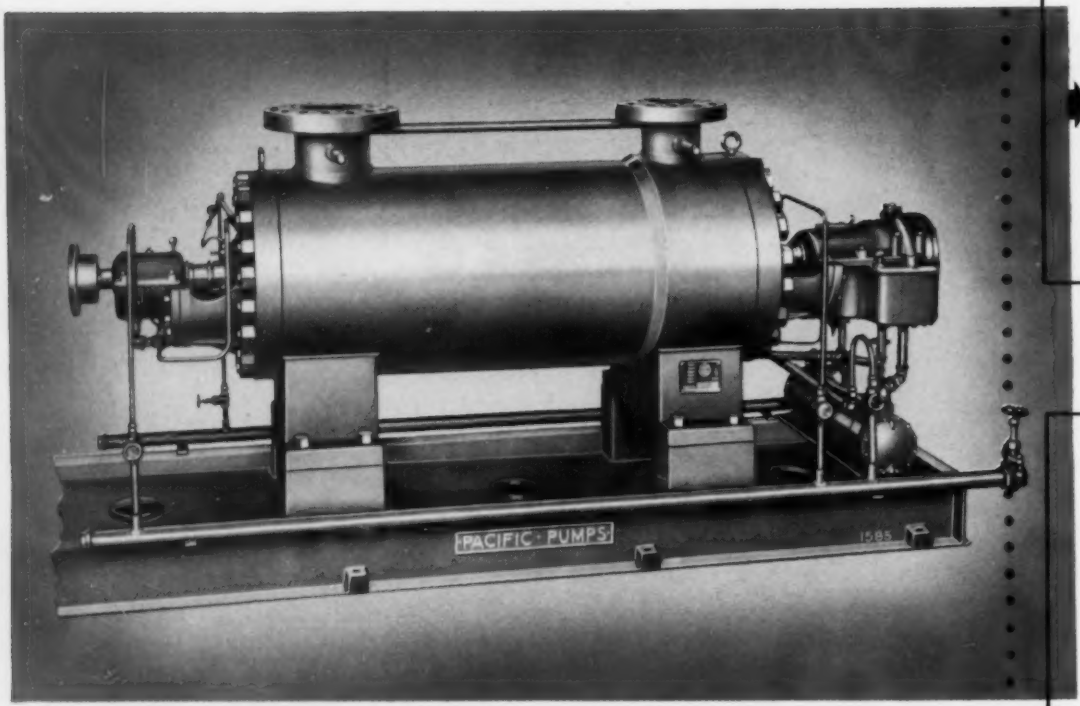


HARD ON THE OUTSIDE, TOUGH ON THE INSIDE

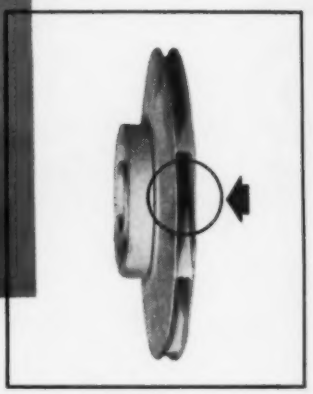
Rollers and races of Timken bearings are case-carburized to give a hard, wear-resisting surface and a tough, shock-resisting core. Result: longer bearing life.

The Timken Company leads in: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. special analysis Timken steels.

What will Pacific CENTRIFUGAL PUMPS *do for you?*



THE NEW
New impeller ready for installation.



THE WORN
Impeller after 11 years' service.

● *They will last and last . . . give you years of trouble free service!* Pacifics are built in types to meet your requirements . . . they will deliver up to 2700 gallons per minute of cold or hot water at discharge pressures up to 3000 pounds per square inch.

Their strength and toughness is created by using carbon and alloy steels. The bearings for multi-stage pumps are pressure lubricated. Bearings for all types are sealed against dust and dirt. The result is less down time, fewer replacements and much longer pump life. Pacific Pumps *set new service records*—time after time.

PACIFIC *Precision Built* **PUMPS**

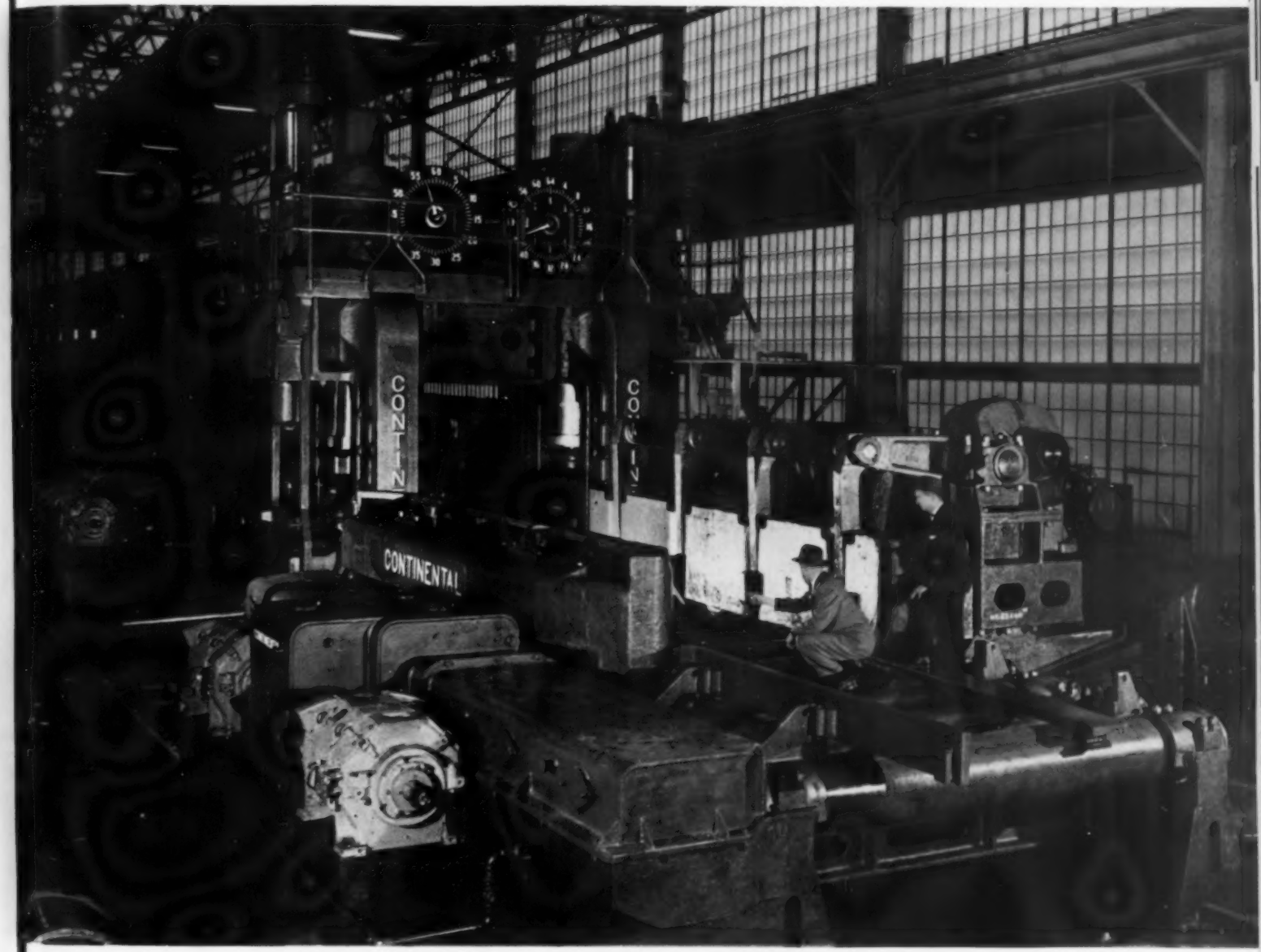
Pacific Pumps inc.
ONE OF THE DRESSER INDUSTRIES

HUNTINGTON PARK, CALIFORNIA
Export Office: Chanin Bldg., 122 E. 42nd St., New York—*Offices in all Pricipal Cities*

1S-1

CONTINENTAL

46-INCH HIGH LIFT BLOOMING-SLABBING MILL



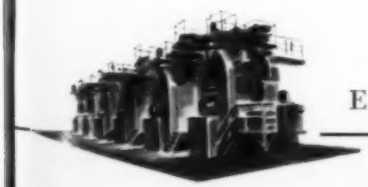
Complete Rolling Mill Installations

SLABBING MILLS	Mills complete with Auxiliary Equipment	BLOOMING MILLS
UNIVERSAL MILLS		STRUCTURAL MILLS
PLATE MILLS	★ ★ ★	RAIL MILLS
HOT STRIP MILLS	CONTINENTAL CHIPPER	BILLET MILLS
COLD STRIP MILLS	ROLL LATHES	ROD MILLS
TEMPER MILLS	SPECIAL MACHINERY	MERCHANT MILLS

CASTINGS—carbon and alloy steel from 20 to 250,000 pounds

ROLLS—iron, alloy iron and steel rolls for all types of rolling mills

WELDMENTS—fabricated steel plate, or cast-weld design

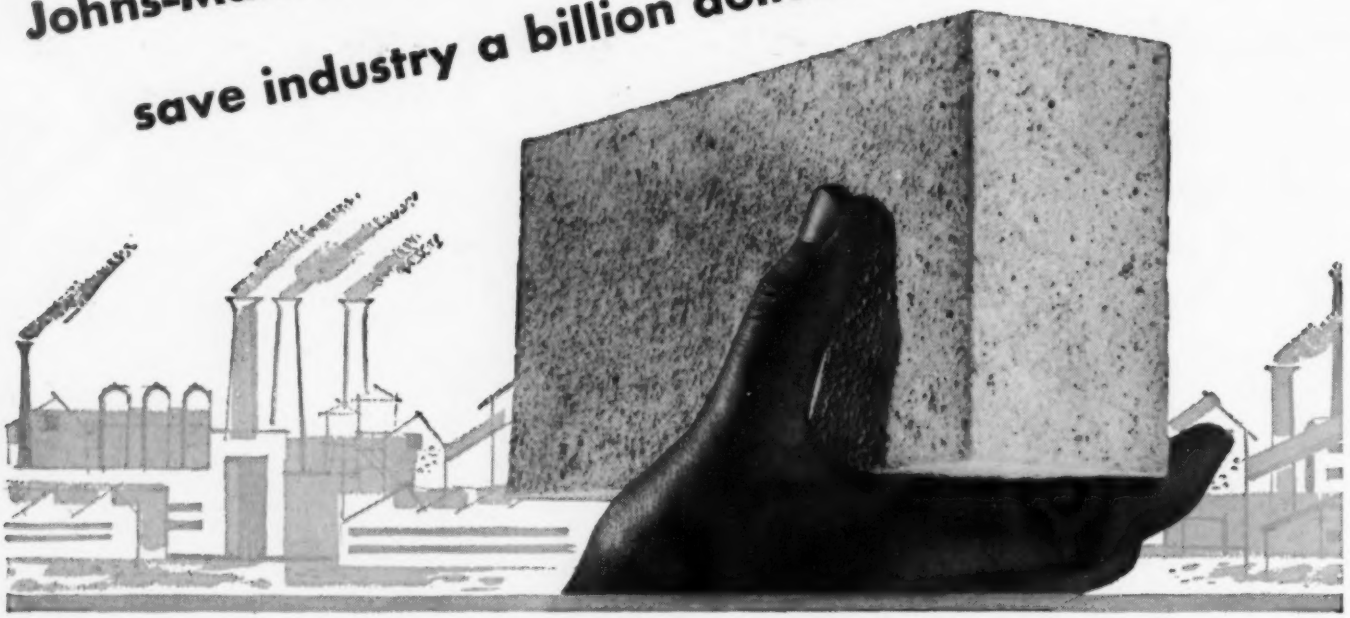


Plants at
East Chicago, Ind. • Wheeling, W. Va. • Pittsburgh, Pa.

CHICAGO • PITTSBURGH

CONTINENTAL
Foundry & Machine
Company

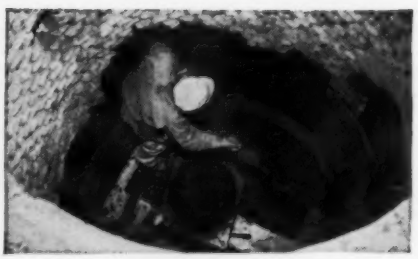
Johns-Manville Insulations save industry a billion dollars in fuel every year!



Reduce your fuel costs and build better furnace linings with JM-3000 INSULATING FIRE BRICK

HERE'S THE ONLY insulating fire brick that withstands a full 3000F. It's highly efficient both as an exposed refractory lining or as back-up insulation. And JM-3000 is only one of six types of Johns-Manville Insulating Fire Brick made for these applications. All provide long-life insulation. All are light in weight, have low conductivity, high structural strength. These properties permit thinner furnace walls—yet you can achieve important fuel savings and increased production, because J-M Insulating Fire Brick assures quick furnace response.

Sil-O-Cel* Insulating Brick is another outstanding J-M fuel-saver . . . a high load-bearing brick for back-up insulation behind refractory linings. It comes in three types, for service through 2500F—makes it possible to reduce the necessary thickness of refractory linings as much as one-third.



Save fuel with J-M Hydraulic Setting Refractories

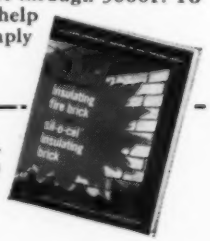
Johns-Manville refractories meet every need for castable, troweling and gunning applications for temperatures through 3000F. *Firecrete** is used to cast special shapes of all kinds. It is ready for use within 24 hours, has negligible shrinkage and high resistance to spalling. *Blazecrete** is used to build and repair furnace linings. When gunned, it adheres readily with a minimum of rebound loss. When slap-troweled, it eliminates laborious ramming and tamping.

Save Fuel with J-M Aggregates and Fills

These lightweight insulations are used as fills to conserve heat in irregular spaces where other forms of insulations cannot be economically applied. They are also used as aggregates for mixing with other materials to form insulating refractory concrete.

*Reg. U. S. Pat. Off.

Send for your free copy! This new booklet IN-115A gives full details about J-M insulating materials for service through 3000F. To find out how they can help cut your fuel costs, simply mail coupon.



JOHNS-MANVILLE PRODUCTS

Johns-Manville

***FIRST IN* INSULATION**

Johns-Manville, Box 60, N.Y. 16, N.Y.
(In Canada, 199 Bay St., Toronto 1, Ont.)
Please send me, without charge, copy of brochure IN-115A

Name_____

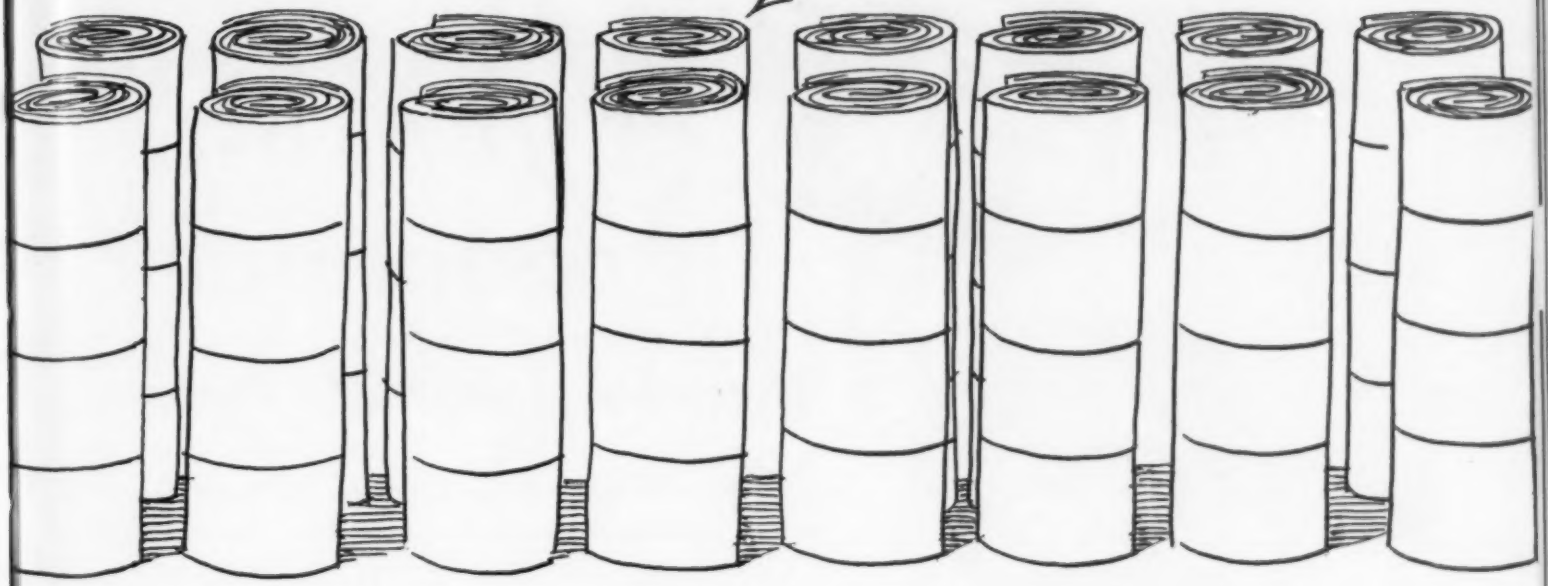
Company_____

Street_____

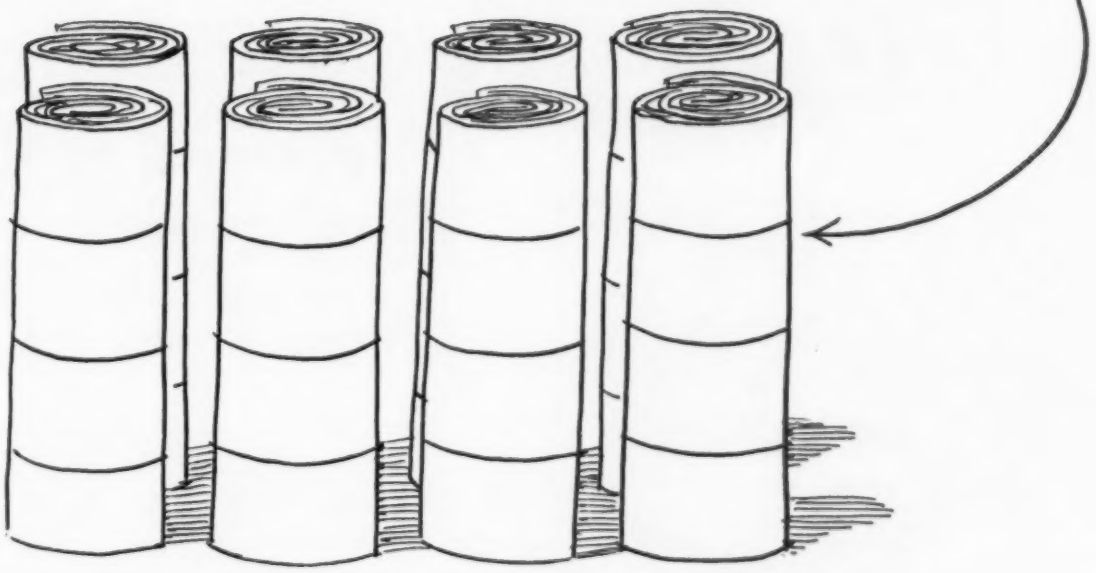
City & Zone_____ State_____

New LEE WILSON Single-Stack Portable Base System

Anneals This



While Conventional Multiple-Stack Furnaces (Same Space - Same Time) Anneal Only This



A Lee Wilson engineer can show you in a few minutes just how the amazing new Lee Wilson Single Stack Portable Base System can **double** your present annealing production without additional time or space.

And steel annealed by this revolutionary new system receives a better, more uniform and easier to control annealing.

If you are thinking about additional annealing equipment be sure you talk with a Lee Wilson engineer before you buy. We are certain you'll be glad you did.

For your files Lee Wilson has a brochure that outlines the more important aspects of this great new system. Write for your copy today on company letterhead.

GET THE FACTS

WRITE FOR FULLY ILLUSTRATED BROCHURE

Lee Wilson

ENGINEERING COMPANY, INC.

20005 WEST LAKE ROAD • CLEVELAND, OHIO

AJAX

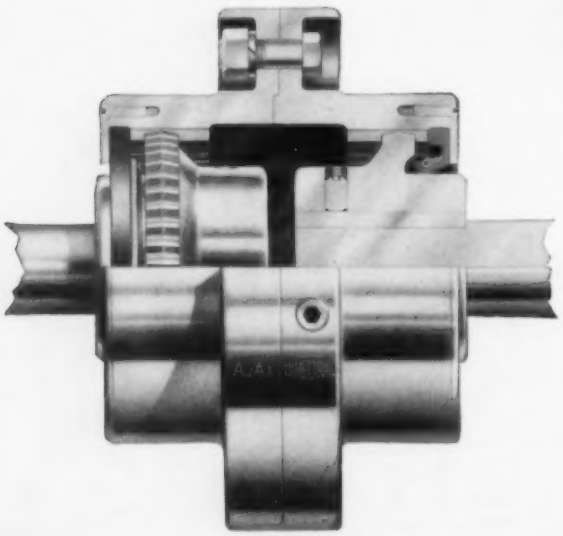
FLEXIBLE couplings

Standard For 30 Years

★ Ajax Rubber-Bronze Bushed and Neoprene Couplings combine positive drive with resilient flexibility for protecting direct-connected machines. They are made in a wide range of sizes in standard, shear pin, bolt-on, brakedrum and other types. Available with flanges made of cast semi-steel, drop forged steel, aluminum and bronze to suit requirements. Write for catalog.

AJAX DIHEDRAL

couplings



Designed to Handle Misalignment up to 4°

TEETH CAN BE CUT TO ORDER TO HANDLE GREATER MISALIGNMENT

★ Save thousands of dollars spent on lining up equipment. Simplifies machine design, installation and maintenance. Exclusive Ajax tooth shape provides for maximum misalignment with tooth clearances (backlash) kept to lubrication film requirements. Positive seals keep lubrication in and dirt out. Write for new bulletins covering standard, floating shaft and mill motor types.

AJAX FLEXIBLE COUPLING CO. INC. WESTFIELD, N. Y.

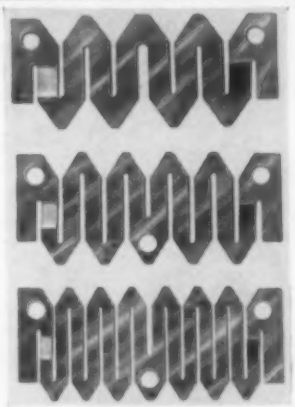
Representatives in Principal Cities

EC&M PLATE RESISTORS
designed for efficiency

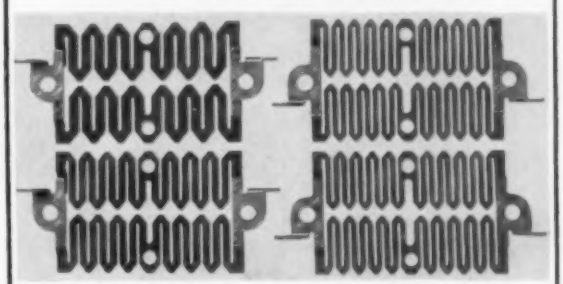
WIDTHS AND OPENINGS MATCHED TO AMPERE AND RADIATION NEEDS

EC&M *Welded Plate* Resistors, available in continuous capacities from 13 to 150 amperes, meet resistor requirements with a minimum number of sizes, and with each size efficiently proportioned to give topmost performance.

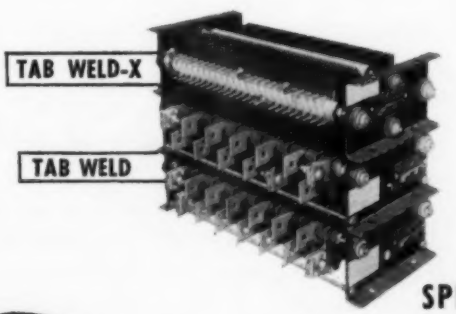
Spacing between individual grids is liberal—from $\frac{3}{8}$" to $\frac{3}{4}$"—eliminates crowding and permits good radiation. Only insulating spacers are required between grids, because grid-ends mate with adjacent grids, and are welded to provide continuous current-path, independent of end clamping-nut pressure. This construction *stabilizes* the OHMIC value, *stops burning* at grid-eyes and at tap-plates.



Nos. 1, 2 & 3 TAB-WELD Grids
3 thicknesses per design gives 9 sizes



Nos. 4, 5 & 6 TAB-WELD-X Grids
with No. 6 furnished in 2 thicknesses



SPECIFY EC&M BULLETIN 942 WELDED PLATE RESISTORS

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

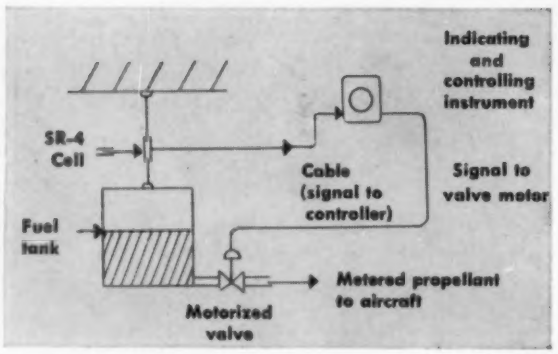
THE PROBLEM

For their rocket engine research and production, Bell Aircraft Corporation was designing a new instrumentation system. Their problem was finding a way to meter the propellant consumption remotely.

THE BALDWIN SOLUTION

Bell's requirements were met by a Baldwin SR-4 special type U Load Cell with a 160 pound capacity. As indicated in the sketch at left center, the fuel feed tank is suspended from a cable which is attached to the load cell so that the entire gross weight of the tank and fuel is supported by the cell.

SR-4 DEVICES IN INDUSTRY...
USES UNLIMITED



This system benefits Bell in these three ways:

1. The fuel consumption can be indicated and controlled remotely because the only connection from the SR-4 cell to the instrument is through electric cable.

2. Because of special aluminum construction this cell resists corrosion by common propellants such as hydrogen peroxide and nitric acid provided that cell is washed off after any accidental contact with them.

3. The need for maintenance is virtually eliminated by the rugged construction and by the absence of moving parts.

The uses of SR-4 devices throughout industry are unlimited. For further information about how they might cut your costs and time for measuring loads, pressure or torque, please write Dept. 3117, Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Pa.

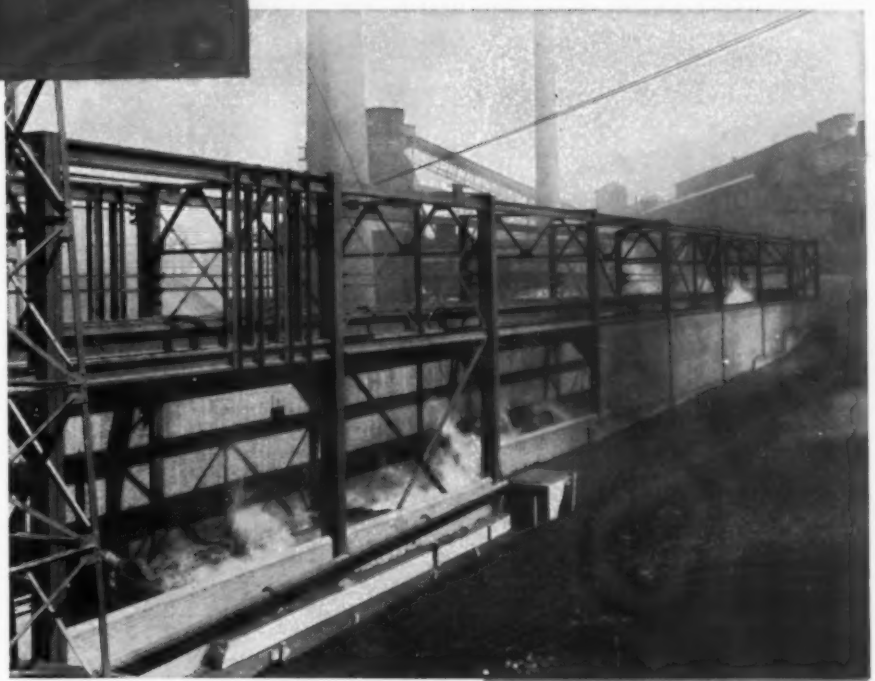
TESTING HEADQUARTERS

BALDWIN - LIMA - HAMILTON

General Offices: Philadelphia 42, Pa. • Offices in Principal Cities

INSUL-MASTIC
The Superior Coating

. . . protects metal equipment where coke quenching fills the air with acid vapors.



This spot is considered one of the most corrosive areas in a steel mill. That's why this crane runway is coated with INSUL-MASTIC 4010. The pit under this runway receives all the steaming, acid laden water from freshly quenched coke in a mill where the water must be used over and over. All year long gnawing vapors rise from the pit and cover the steel runway. No damage results, but look at what the vapors have done to the painted steel at the far left.

INSUL-MASTIC is the *Superior* coating that protects for a great many years. Its Gilsonite content makes it practically inert to acids. Its mica content makes it almost immune to weather. It's homogenized so that nothing settles in the drum . . . it is sprayed as it is blended. It is applied 1/16″ to 1/8″ thick in one coat.

All this adds up to a *Superior* coating . . . and this crane runway is only one of the many corrosive areas in steel mills where INSUL-MASTIC guards against the attacks of corrosion.

Write for the name of your nearest INSUL-MASTIC Representative for expert advice on protecting your equipment where coke quenching and other sources of corrosion take place.

Think first of the coatings that last!

CORROSION PROOFING
WATERPROOFING
VAPOR SEALING
INSULATION

Type "D"—The cork impregnated coating that insulates as it prevents corrosion.

4010 and granules—An attractive, weather resistant resurfacing for old or leaky masonry walls.

Insul-Mastic

CORPORATION OF AMERICA
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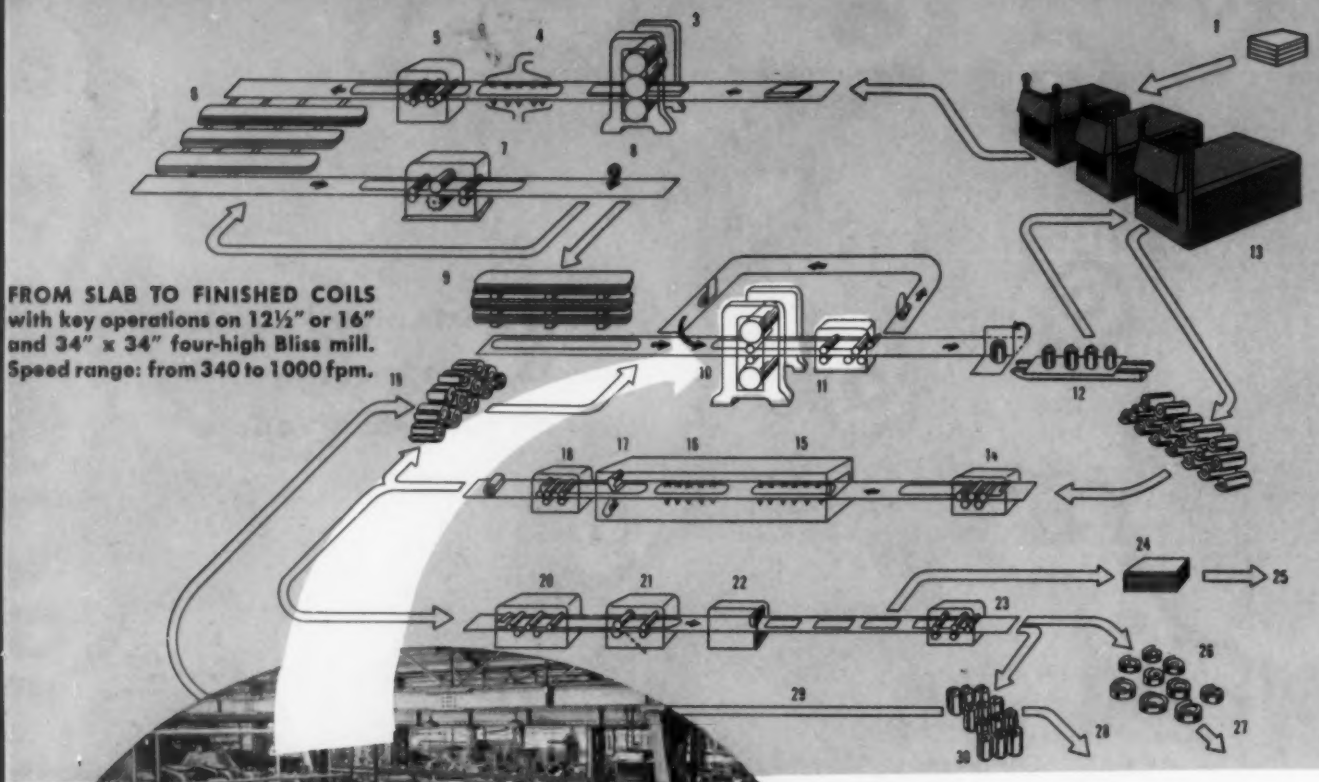

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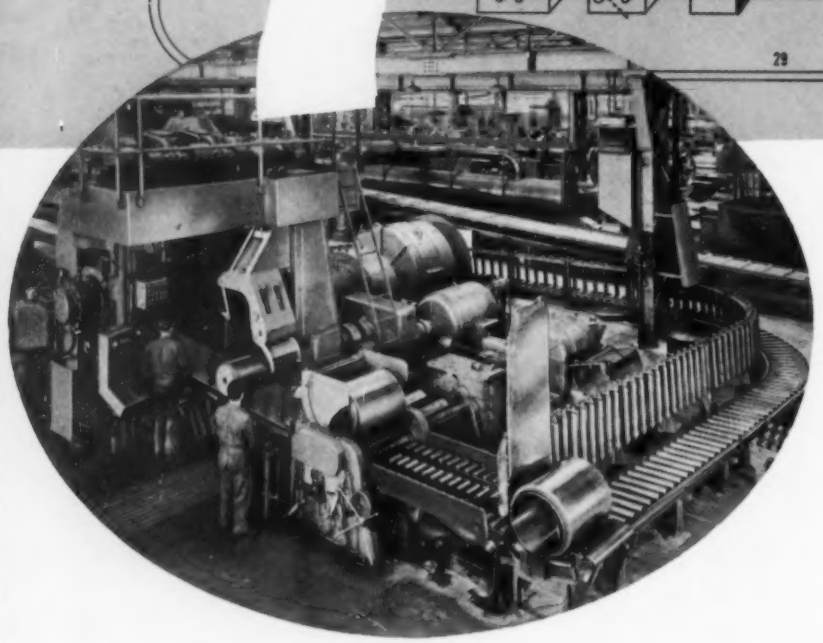

New BLISS Mill is key unit in major Swiss plant modernization

When Metal Works Ltd., Dornach, Switzerland, decided to modernize their rolling mill equipment after World War II, they made a detailed study of American and European machinery and methods. Findings proved that a new four-high cold mill would be the most important unit. Exacting specifications for this cold mill were established. Then various designs were studied. *Their choice—Bliss'* versatile four-high mill design.

Here's why: The single Bliss Combination Run-down and Finishing Mill would deliver an output equal to that of 12 old mills... give seven times the speed range ...more than double the reduction capacity. In addition, its rigidity and built-in controls would enable the Bliss mill to deliver finer tolerances than heretofore possible. Result: Officials of Metal Works Ltd., report that "the mill was very quickly in full operation with a minimum of teething problems... the heavy specification has been more than paid for."

Developing the right mill design for a given set of production conditions has been a highlight of Bliss engineering for many years. Next time you have a mill problem, call for a Bliss engineer. Meanwhile, write for your copy of Bliss' 52-page brochure—Bulletin 40.

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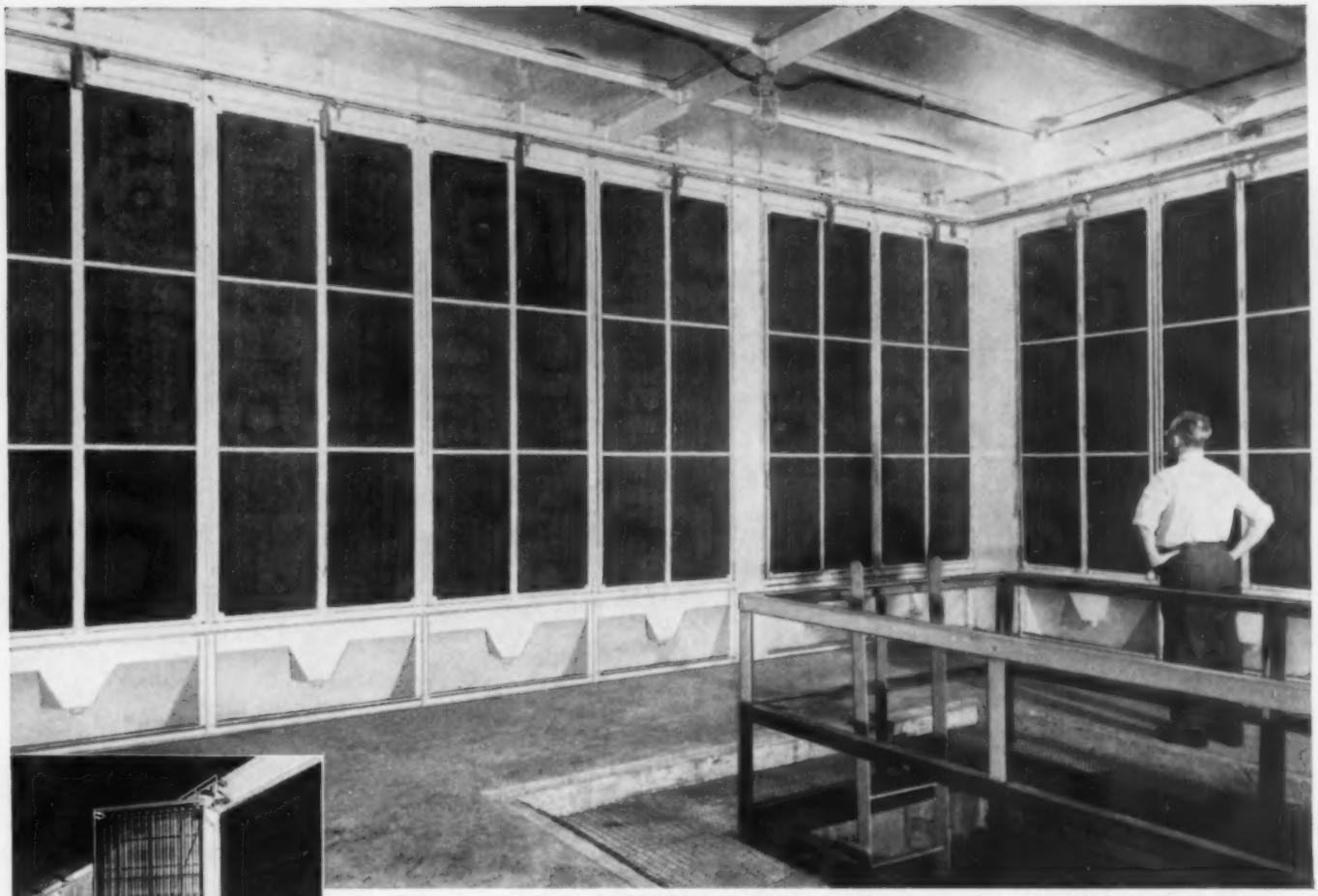
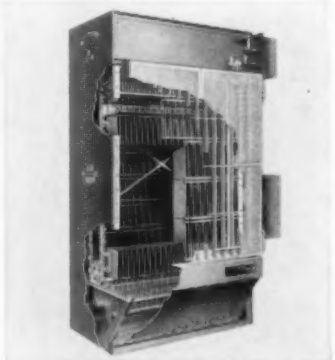


Rear view of a bank of ELECTRO-MATIC precipitators at work in a big Midwest steel mill.

Front view of the steel mill ELECTRO-MATIC installation shown above. Note the hinged ionizer section opened which permits ready access to the rear of the ionizer unit—and to the front collector curtain.



Above is a cutaway of the ELECTRO-MATIC Model "E-2" showing the construction details and the arrangement of the various components. The photo shows the spacing of the collector plates which makes the filter curtain non-clogging—assuring a constant flow of clean air of uniform volume.

THE AAF ELECTRO-MATIC self-cleaning electronic precipitator provides a constant volume of

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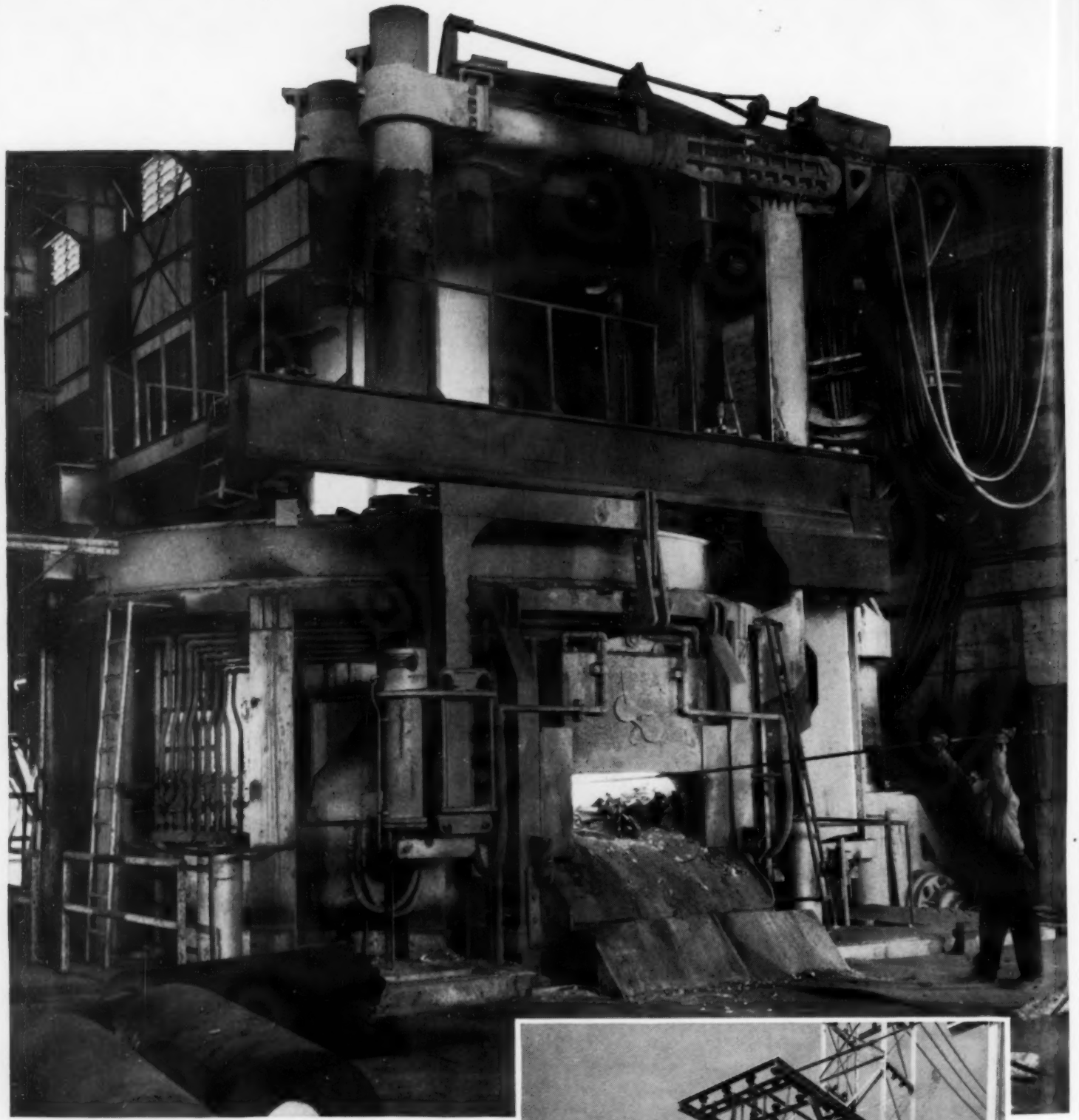

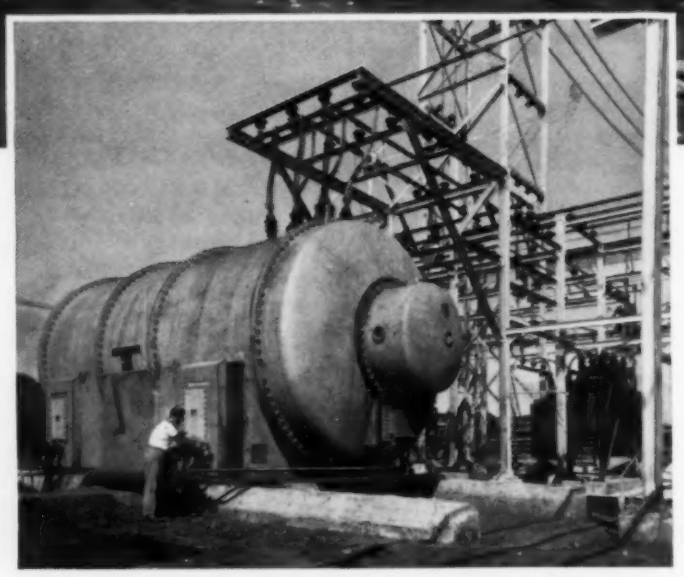

This Northwestern Steel & Wire Company furnace, at Sterling, Illinois, is the largest arc furnace in service in the world. The first of three such furnaces being installed here, it's expertly controlled by Westinghouse Rototrol.

Northwestern's new 60/70,000 kva synchronous condenser, built by Westinghouse, has helped increase the power system's stability and has eliminated light flicker.

Westinghouse package boosts furnace output, cuts power costs

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Westinghouse engineers will help you plan a complete, one-package electrical installation, including a power supply setup that can handle tremendous loads. Look, for example, at the new Westinghouse synchronous condenser, pictured at the lower left. Installed at Northwestern Steel and Wire Company for the world's largest arc furnace, this unit absorbs peak power requirements and minimizes disturbances to the electrical system.

Two electrical brains

Westinghouse Rototrol® maintains desired power input by quickly, accurately and automatically adjusting the electrode position, according to changing furnace demands. Optimelt®, another Westinghouse development, can provide even more precise control by automatically determining the best kw input.

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To withstand the power surge when the furnace electrode touches the charge, Westinghouse supplies a shell-form transformer . . . far stronger than other types of construction. Also, Westinghouse has developed new hard-working air-blast circuit breakers. These provide 500 kva interrupting capacity for furnaces up to 1200-2000 amperes. Imaginative engineering like this helps explain why more Westinghouse furnace equipment is in use than all other makes combined.

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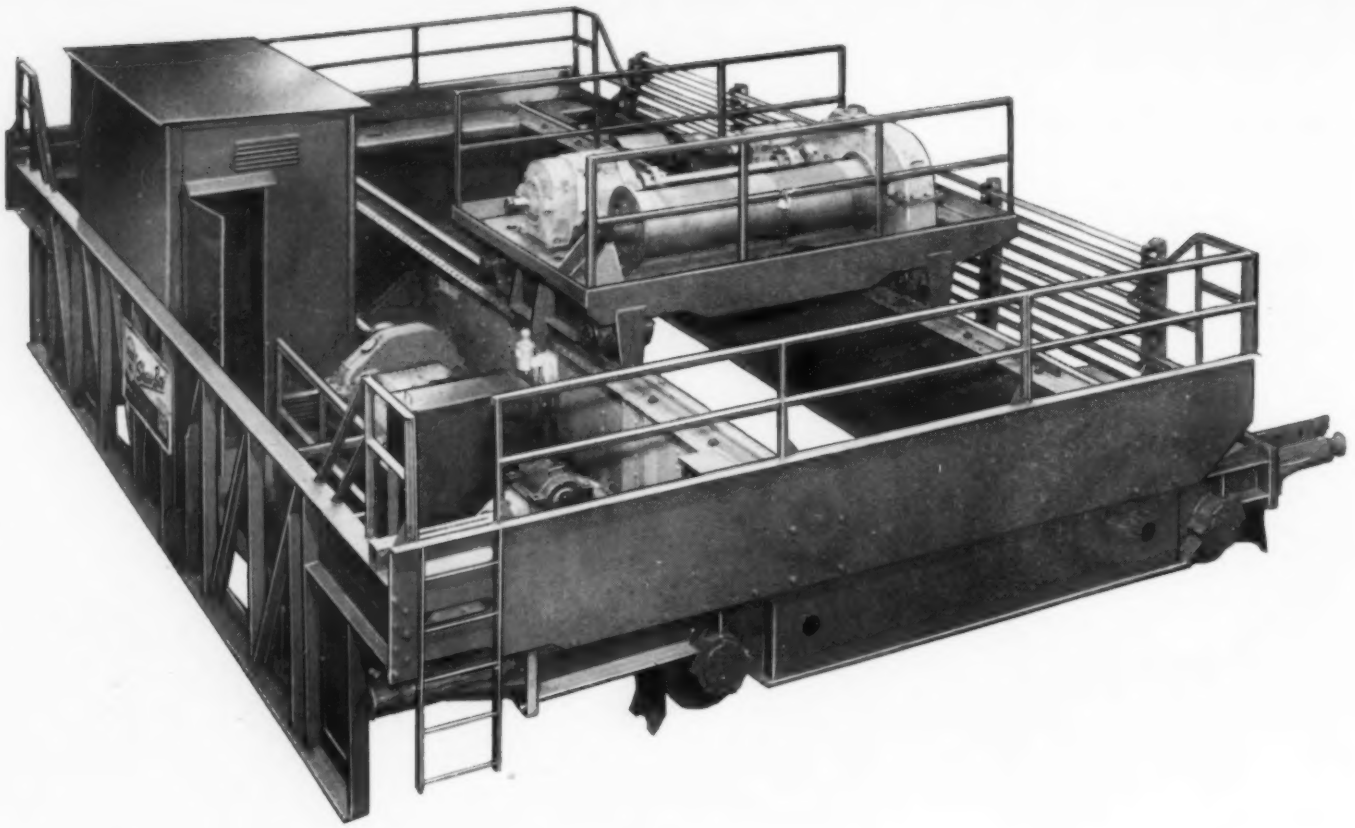

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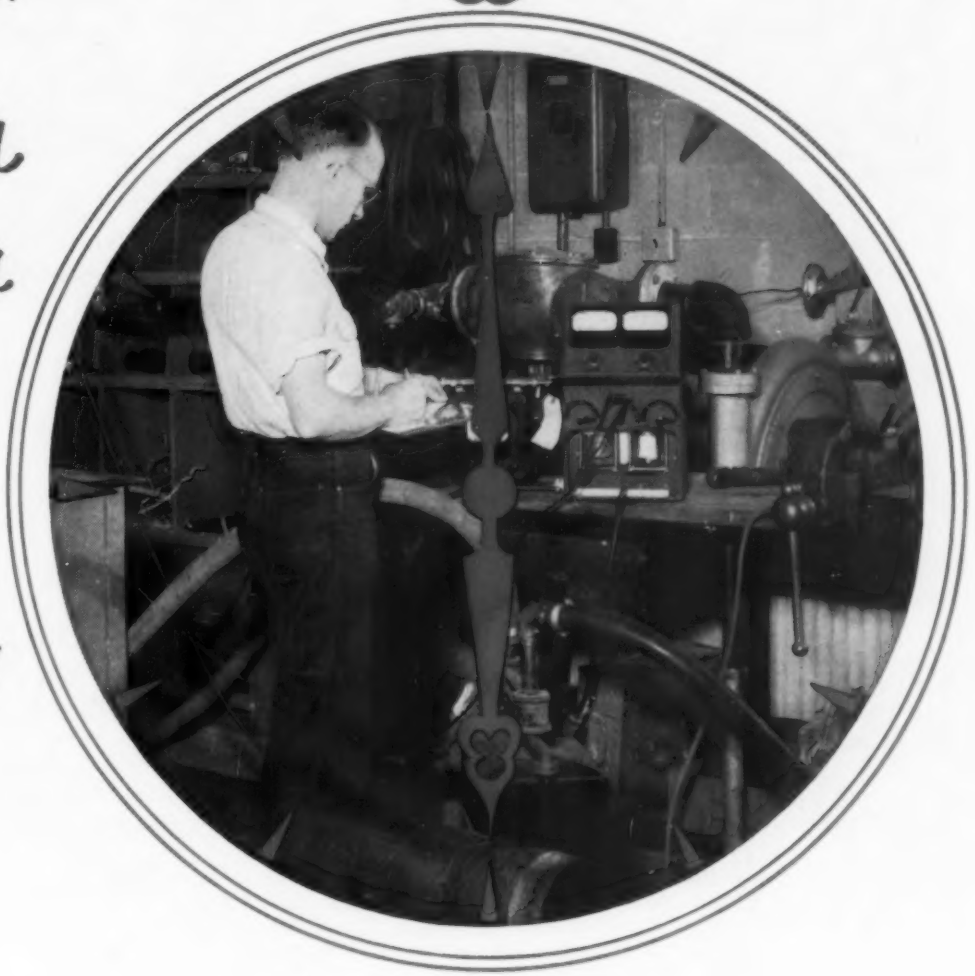

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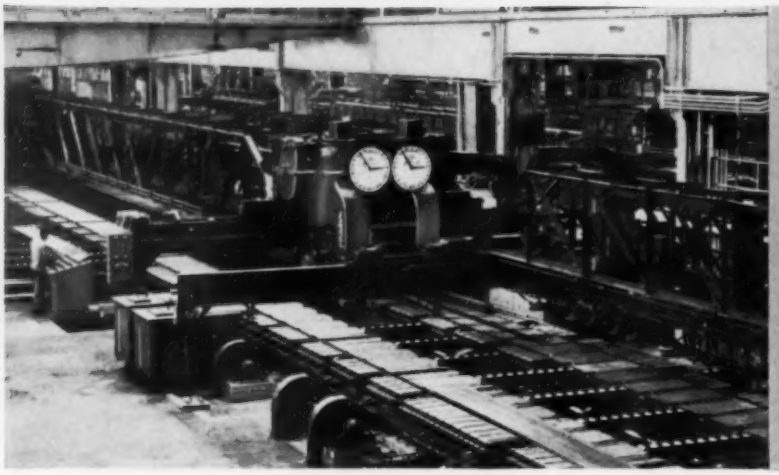

In this breakdown mill installation, cold brass bars 2200 lbs. in weight are reduced in a series of passes from 2½" to .400". Nearly 1,500,000 lbs. of metal can be rolled during an eight-hour shift, the rolling operation and all handling equipment being completely controlled by two operators, each at a control desk on either side of the 30" x 36" mill. Suction cup pilers and unpilers, hydraulically operated, move the bars from point to point. Stacks of bars are returned for the succeeding pass or transported to the annealing oven by chain transfer.

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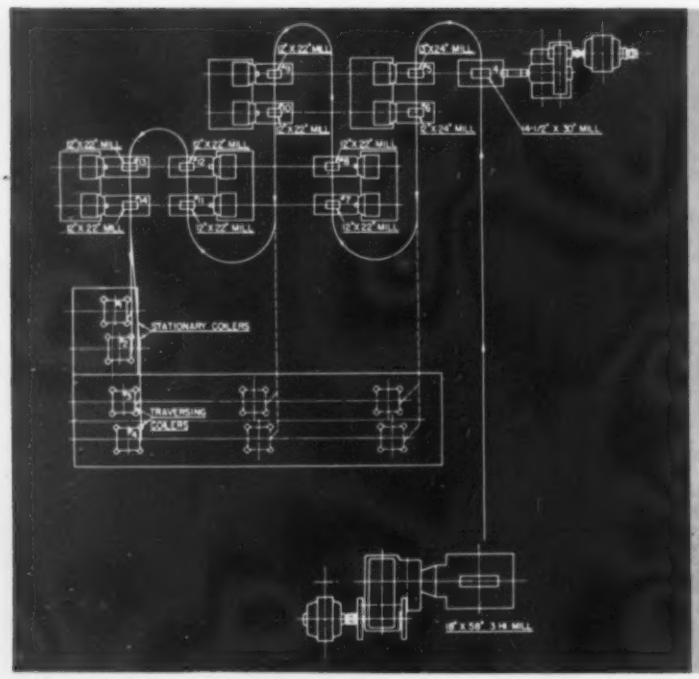
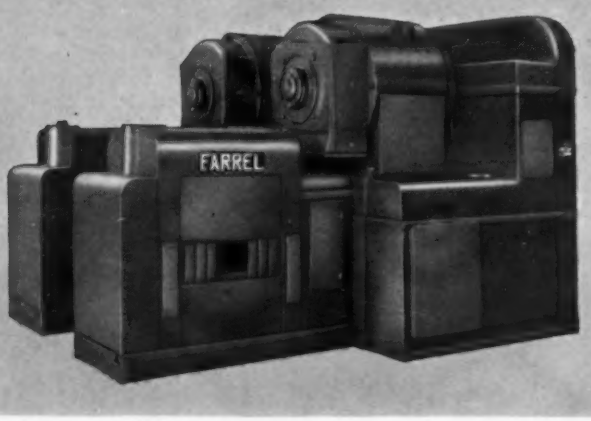


Layout of hot copper rod rolling mill, consisting of five tandems of two mills each, coilers and breakdown mill. Engineered by Farrel-Birmingham, this entire setup is fully automatic, requiring no operators on the floor. The flow of material is uninterrupted from billet breakdown to final pass.



By MELVIN NORD, Patent Attorney, Detroit, Mich.

Patent Reviews

. . . . copies of patents may be obtained from the Commissioner of Patents, Washington 25, D. C., at 25 cents each . . . . patents reviewed cover period February 24, 1953 through March 17, 1953 . . . .

INSTALLATION FOR RECLAIMING BLAST-FURNACE FLUE DUST

▲ Flue dust carried off by the gases of a blast furnace produces a material loss of iron production due to the relatively large proportion of iron oxide which is carried off by the blast furnace gases. If relatively fine ores such as Massaba ores are used, the loss is particularly large. Average values of flue dust in the outlet gases leaving at the top of the blast furnace are from 10 to 45 gr per cu ft of the gases but much higher values have been registered in some plants.

Flue dust contains iron oxide, carbon, and lime, which are all derived from the original charging material. The flue dust consists of small particles of coke and of undecomposed ore and limestone thus representing clearly a loss of these materials for the production process.

Attempts have therefore been made to recharge the flue dust into the blast furnace. The flue dust is always separated from the gases which carry it because the gases are utilized for combustion processes carried on in conjunction with the main process or in a collateral process. Therefore, the flue dust is invariably separated out and has to be disposed of. Reintroduction of the flue dust into the blast furnace as such does not produce any material advantage, since the particles are of such fineness that they are carried out of the furnace again as flue dust. Very little of the flue dust enters into and is absorbed by the production process. Further, the reintroduction is accompanied by a material lowering of the output which more than counterbalances a small gain which might otherwise exist.

Attempts to reduce these losses frequently include steps intended to bring the flue dust into some aggregate form in which recharging can take place without the disadvantages due to the fineness of the particles. A sintering, nodulizing, or briquetting process is commonly used for this purpose. Such a process, however, can only be carried out with the addition of relatively large quantities of additional fuel, and expensive and bulky equipment is usually necessary. Moreover ore fines, combustible adhesives, and other substances have to be added to the flue dust either in order to produce the required aggregation or conglomeration or to prevent a packing of the blast furnace which is frequently the consequence of the recharging.

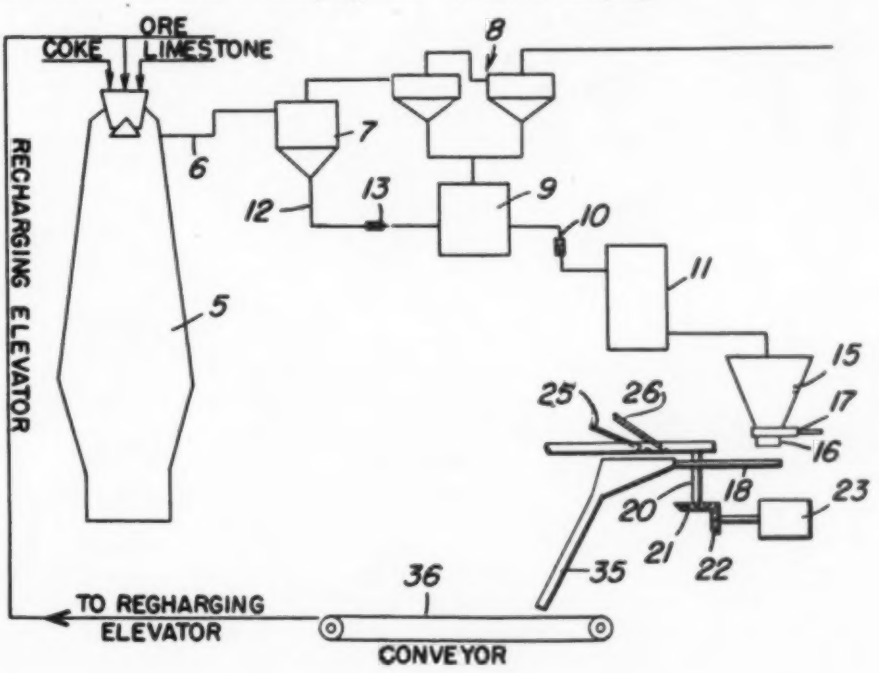


Figure 1

In U. S. 2,631,178, by George E. Morton, the flue dust (after separation from the gases) is passed in a continuous stream between the electrodes of an electric arc. The electric arc produces a temperature which is high enough to fuse the flue dust particles in quantities so that the entire stream, during its passage between

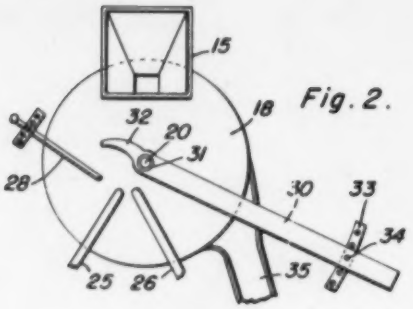


Fig. 2.

Figure 2

the electrodes, is converted into pellets and clinkers which may then immediately be recharged into the blast furnace.

The process may be carried out by means of a rotating table on which the flue dust is piled up continuously in a heap of a certain elevation and of limited width, the said width being such that the piled up material may pass the space between the common electrodes between which the electric arc has been struck. The rotating table forms the transportation means for the material from the point at which the flue dust is delivered to the point at which it is discharged. This is illustrated in Figure 1. Figure 2 is a diagrammatic plan view of the rotating table.

A second method is to use an inclined rotating drum, as in Figure 3. The flue dust advances along the bottom of the drum in a stream of limited width. It is thus carried through the space between and around the electrodes projecting into the drum from the outside.

In Figures 1 and 3, the blast furnace gases pass into a coarse dust catcher 7 and then enter the washer or gas cleaner 8. The gas washer generally operates in two stages. The collected wet dust is discharged into a mixer 9 where a sludge is formed, which is ultimately discharged into a sludge pit 11 where it settles. After the passage of the dust through the electric arc, the pellets thus formed are conveyed to an elevator leading to the top of the blast furnace, where they are recharged.

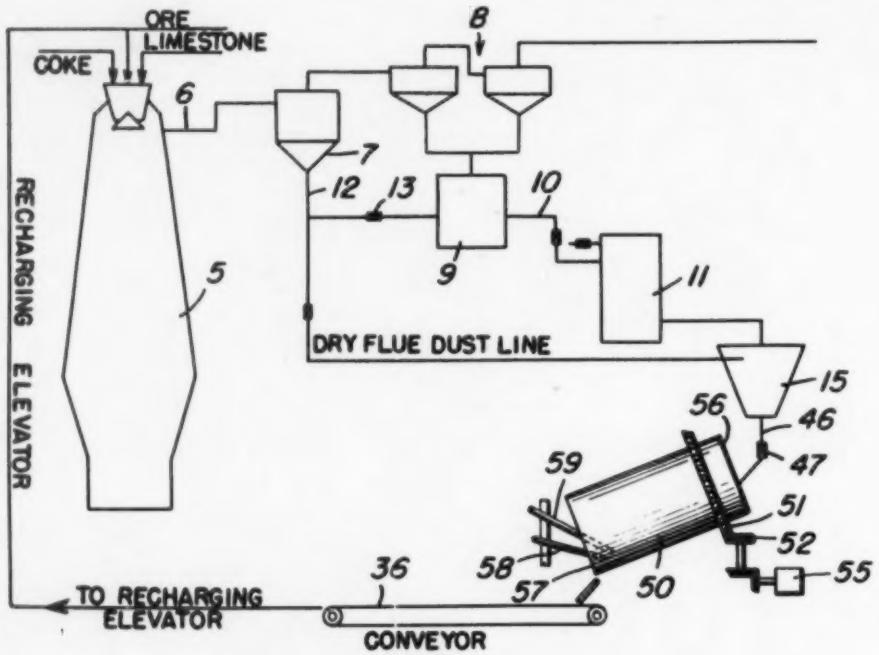


Figure 3

CUPOLA DUST ARRESTER

Air discharged from a cupola stack carries with it foreign materials, and it is desirable to separate and collect them so that they will not be scattered over the surrounding neighborhood. The separation problem is a difficult one because of the intense heat of the air and of the materials discharged from the stack. At such temperatures it is difficult to separate the material, and the intense heat tends to destroy the material forming the arrester in a comparatively short time.

In U. S. 2,630,880, by John D. Schmieg, assigned to Schmieg Industries, Inc., an arrester is provided which consists of an upwardly diverging cone open at both ends, and so positioned that the top of the cupola stack projects within the cone through the bottom, smaller end. The bottom end of the cone is spaced radially about the stack and is open to the atmosphere, so that a Venturi effect results which causes air to be pulled into the separator from the atmosphere, the colder atmospheric air enveloping the air discharged from the stack. This causes a considerable reduction in the temperature of the air issuing from the cupola, resulting in lower operating temperatures, thereby prolonging the life of the apparatus.

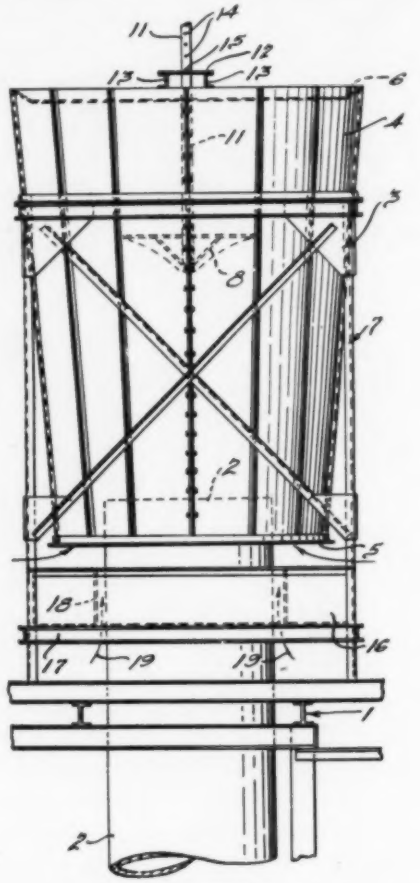
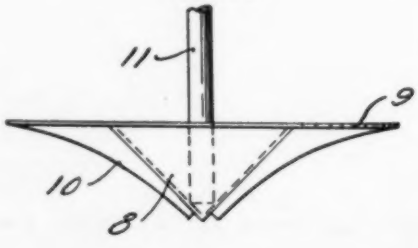


Figure 4

Figure 4 is a side elevation showing the dust arrester in its relationship to the cupola stack. Figure 5 is a side elevation of a baffle 8, and Figure 6 is a bottom view of the same baffle.

The blast of air issuing from the cupola stack 2 moves up through the hollow cone 4, drawing in atmospheric air as indicated by the arrows

Figure 5



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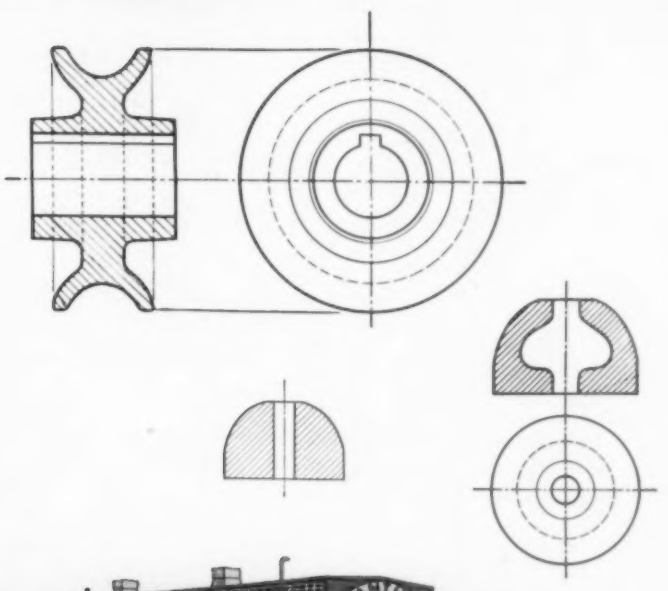

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Youngstown Alloy Casting Corp.
Youngstown, Ohio

in the diagram. As the cooled air moves upwardly through the cone 4, the baffle 8 and the spiral vanes 10 create a spiralling action which assists in the separation of the particles. An annular flange 6 at the top of the apparatus also assists in the separation.

In order to collect the heavier particles as they are separated from the air and as they drop to the bottom, an annular pan 16 may be supported on a frame 17. Dust dropping outside the cupola stack is thus caught in the pan. The pan is small enough to allow atmospheric air to rise between it and the cupola stack, as indicated by the arrows in Figure 4, thus preventing overheating of the pan.

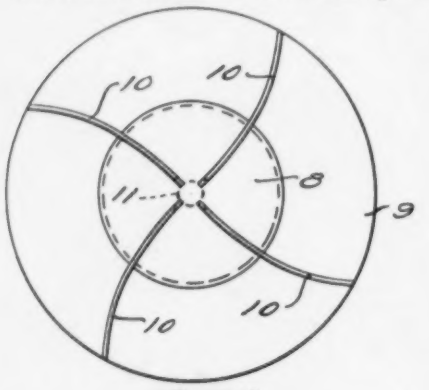
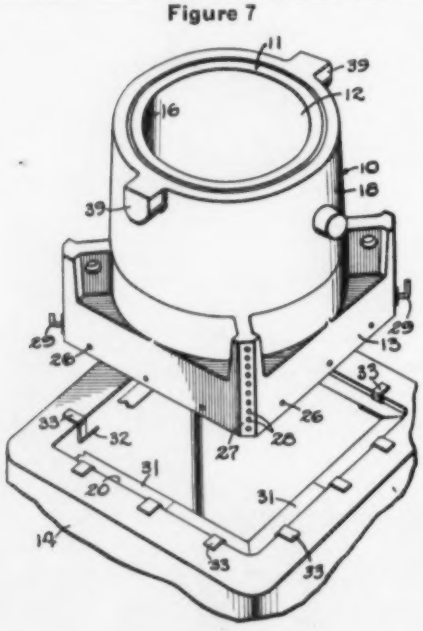


Figure 6

REFRACTORY HOT TOP FOR INGOT MOLDS

In U. S. 2,629,152, by Walter F. Milburn, a refractory hot top for use with rectangular ingot molds is described. As shown in Figure 7, the upper part of the hot top is circular, while the lower part is rectangular. It is claimed that this reduces the cooling rate in the hot top while still insuring complete filling of the mold with molten metal. Details of construction are disclosed in the patent specification.

Figure 7



CASTING OF INGOTS WITH GOOD SURFACES

In U. S. 2,631,344, a method is presented for casting ingots with surfaces substantially free of imperfections such as cracks, pits, or occlusions. The inventor is Harry E. Kennedy, and the patent is assigned to Union Carbide & Carbon Corp.

Shells of fusible silicate materials are cast in the conventional molds, and the steel is then cast inside the silicate shell. It is necessary that the inner walls of the silicate shell, which will be in contact with the steel during casting, be at a temperature higher than that of the outer walls of the shell, in order to prevent thermal spalling of the silicate shell. The inner wall temperature should be close to the solidus of the silicate material, so that metal splashings will not adhere to the surface of the silicate shell, but will tend to liquefy the surface of the shell. It is also of primary importance that the outer walls of the silicate shell be at a temperature sufficiently low to freeze the molten steel so that it will solidify in contact with the shell and not come into contact with the mold wall.

One way of preparing the silicate shell is to pour the molten silicate material into a cool ingot mold, thereby forming a solidified shell of substantial thickness. The remaining molten silicate is then removed through a tap hole. Alternatively, it may be left in the mold while the molten steel is poured in, the rising molten silicate forming a shell on successive zones of the mold wall. In the latter case, it is important that the excess molten silicate be safely above the freezing point of the metal, in order to produce a sound ingot. This problem is obviated, however, if the excess molten silicate is removed before the molten steel is poured into the mold, and that is therefore the preferred method of operation.

The thickness of the silicate shell should be great enough to prevent penetration by the molten steel. Thicknesses of $\frac{1}{32}$ to $\frac{3}{8}$ in. have been used satisfactorily.

The silicate material must of course not react with the molten metal being cast, and the molten metal should be free of inclusions which would react with the silicate shell. A wide variety of metallic silicates have been used, mostly calcium-magnesium-aluminum silicates. Titania has also been substituted for part of the silica.

Good results are claimed to have been obtained with plain carbon steels, alloy steels, and alloys low in iron, including metals from which it is unusually difficult to cast ingots having acceptable surfaces.

OTHER PATENTS OF INTEREST TO THE IRON AND STEEL ENGINEER

Patent No.	Subject of patent	Inventor or assignee
2,629,272	Rolling mill control for the rolling of thin metals, such as foil	Erwin Loewy
2,629,273	Repeater for rolling mills operating on thin, wide, strip metal	United Engineering and Foundry Co.
2,629,493-4	Concentration of oxidized iron ores by froth flotation in the presence of carbohydrate xanthates	Attapulgas Minerals and Chemicals Corp.
2,629,564	Apparatus for continuously laying wire in a coil	Northwestern Steel and Wire Co.
2,629,589	Flame hardening apparatus for gears used in steel mill drives, etc.	The Lakeside Steel Improvement Co.
2,630,277	Coil stock holding and feeding device	John Haller
2,630,319	Correcting apparatus for strip operations	Armco Steel Corp.
2,630,624	Conveyer with displaceable bar-pulling dog and automatic control, for use in manufacturing seamless tubes	United States Steel Corp.
2,630,633	Gauging device for determining misalignment of land and threads of drill pipes	United States Steel Corp.
2,631,096	Hardenable high-temperature steel	United States Steel Corp.
2,631,361	Method of making welded tubing from strip metal stock	Bundy Tubing Co.
2,631,478	Welding roll dressing device	The Budd Co.
2,631,526	Pipe bundling machine	Republic Steel Corp.
2,631,561	Apparatus for continuously enameling thin sheet metal	Robert G. Calton
2,631,836	Refractory lining for gas port of a soaking pit	United States Steel Corp.

Where continuous flow and maximum capacity are required, use

ZURN

DUPLEX GATE-TYPE Low Pressure Drop LPD STRAINERS

Free Floating Valve Disk, easily removed through the valve access cover, insures against binding of valve operating mechanism.
Hinged Cover with "C" Washer Closure and Multiple Basket design facilitates cleaning; permits one man operation.
Operating Screw cannot be damaged by corrosion or foreign particles in the liquid on the inside or by physical damage on the outside of the strainer.
Large open area ratio (6 to 1) lengthens cleaning cycle relative to conventional style 2½ or 3½ to 1 open area ratio strainers.
Angle Basket design permits straight-through flow, minimizes pressure drop.
Zurn LPD Duplex Gate-Type Strainers can be used for all fluids. They permit high rates of flow with remarkably low pressure drop and immeasurably improve the handling of fluids.

● Design improved for placement of Multiple Catch-Baskets. *This permits straight-through flow which minimizes pressure drop.* Angle Basket design insures complete retention of strained particles when basket is being removed for cleaning. *One man can complete basket cleaning easily, rapidly and at low cost.* Basic face-to-face and centerline-to-base dimensions are favorable for installation in minimum space.

Like all other Zurn LPD Strainers, Duplex Gate-Type Strainers are held at close tolerances for materials, shapes and dimensions assuring the utmost in strength and safety and continuous operation.

Zurn LPD Strainers are widely used to protect close tolerance control devices and delicate mechanisms, also to protect product purity. Zurn LPD Strainer applications include fluid handling lines for lubricating and fuel oil, and oil during the refining process; a wide range of chemicals produced and used by the various process industries; public utility power plants; power stations; industrial plants and ships. They are available for high temperature and high pressure installations. Zurn Fluid Handling Engineers are available for consultation. Write or wire direct to factory.

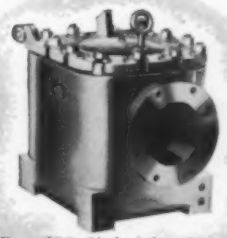
J. A. ZURN MFG. CO.
INDUSTRIAL DIVISION
ERIE, PA., U. S. A.
In Canada: Canadian Zurn Engineering Ltd., Montreal 25, P. Q.

There is a ZURN LPD strainer for every fluid handling purpose

Zurn LPD Duplex Strainer, Plug-Type

Zurn LPD Sinlex Strainer available in offset and straight-through types.

Zurn LPD "Y" Type Strainer available in any cast material and for high pressures.


Zurn LPD Sinlex Strainer, Multiple Basket type, available in several metals and for high temperature installations.

(Zurn Engineered Low Pressure Drop Strainers are patented and patents pending.)

Copyright 1953

WRITE FOR ZURN LPD STRAINER DATA MANUAL NO. 952

This Manual includes *previously unpublished pressure drop data* and gives useful, factual information on fluid handling.

J. A. ZURN MFG. CO. • INDUSTRIAL DIVISION • ERIE, PA., U. S. A.
Please send me Zurn LPD Strainer Data Manual No. 952.

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★

World's largest builders of world's largest cranes

★

ALLIANCE PLAYS A VITAL ROLE

450/75/20-TON, 4-GIRDER LADLE CRANES

When the engineers from the Construction Engineering Bureau of the United States Steel Corporation were in the market for the world's largest ladle cranes for Fairless Works, they consulted The Alliance Machine Company, whose experience and know-how qualified them for this important task.

One of the cranes Alliance designed, which is now operating in the Fairless Works, is this 450-ton ladle crane. Having a 69'6" span, this crane is equipped with a 2-motor, synchronized worm drive and double-drum interlocked type main hoist. The synchronizing shaft employed in the gearing scheme not only eliminates undesirable ratchet gears, but makes possible an additional safety feature in case one hoist motor fails. Under this condition, both worms are driven by the remaining motor. All gearing functions continue as though operated with two motors. In case of hoist motor failure on the conventional drive **without** the synchronizing shaft, hoisting is accomplished by **only one** set of gears, thus imposing a double load on active gearings, as the second drum is then driven through interlocking drum gears.

Hoist gearing is so proportioned that full crane capacity can be lifted by one motor without exceeding the quarter-hour rating.

Drum gears and pinions of the main hoist have precision-cut, single-helical teeth. This feature, in cooperation with the worm drive, provides vibrationless operation on either high- or low-speed hoisting and lowering.

All gears of this new Fairless Works crane are fully enclosed and operate in a bath of oil, assuring long life and low maintenance. The 4-part safety rope system affords the highest degree of safety in rope reeving.

This crane is equipped with a 5-story cab, the operator's compartment being air-conditioned.

Consult Alliance Machine Company engineers when you have a heavy material handling problem.

★ ★

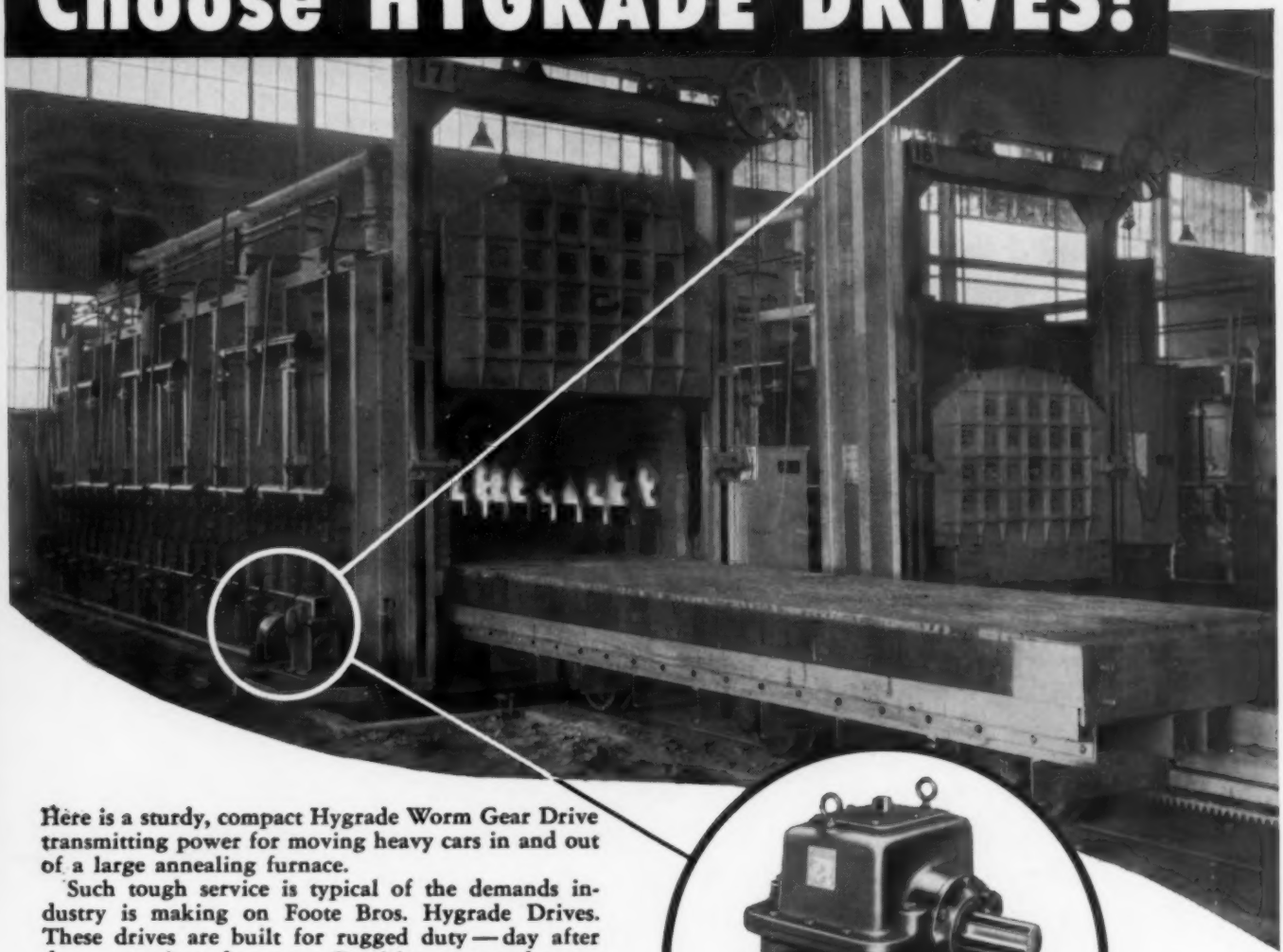
THE *Alliance* MACHINE COMPANY

MAIN OFFICE ALLIANCE, OHIO • PITTSBURGH OFFICE 1622 OLIVER BUILDING, PITTSBURGH, PA.

FOR RUGGED DESIGN

TROUBLE-FREE OPERATION . . .

Choose HYGRADE DRIVES!



Here is a sturdy, compact Hygrade Worm Gear Drive transmitting power for moving heavy cars in and out of a large annealing furnace.

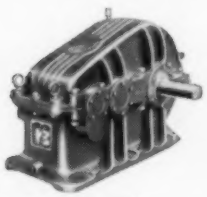
Such tough service is typical of the demands industry is making on Foote Bros. Hygrade Drives. These drives are built for rugged duty — day after day — year in and year out. Precision-processed worm gearing assures highest efficiency and optimum load-carrying capacity. Compact design gives maximum performance in minimum space.

Solve your tough speed reduction problems with Enclosed Hygrade Drives. Horizontal and vertical types available. Ratios to 4,108 to 1, capacities to 260 h.p. For applications requiring long, unsupported output shafts, use Vertical Hygrade in Hytop design.

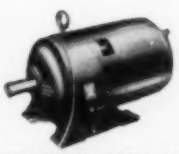
See your Foote Bros. representative or write for information

One of 15 car-type furnaces using Hygrade Drives at Warren, Ohio, plant of Copperweld Steel Company. Installed by Pennsylvania Industrial Engineers Division, Amsler Morton Co.

LINE-O-POWER DRIVES



MAXI-POWER DRIVES



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Better Power Transmission Through Better Gears

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GEAR AND MACHINE CORPORATION
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Chicago 9, Illinois

Please send me a free copy of Bulletin HGB on Foote Bros. Hygrade Worm Gear Drives.

Name.....

Company.....

Address.....

City.....Zone.....State.....

DRAVO
split-type crane cab cooler reduces cab temperatures 65°F at J&L

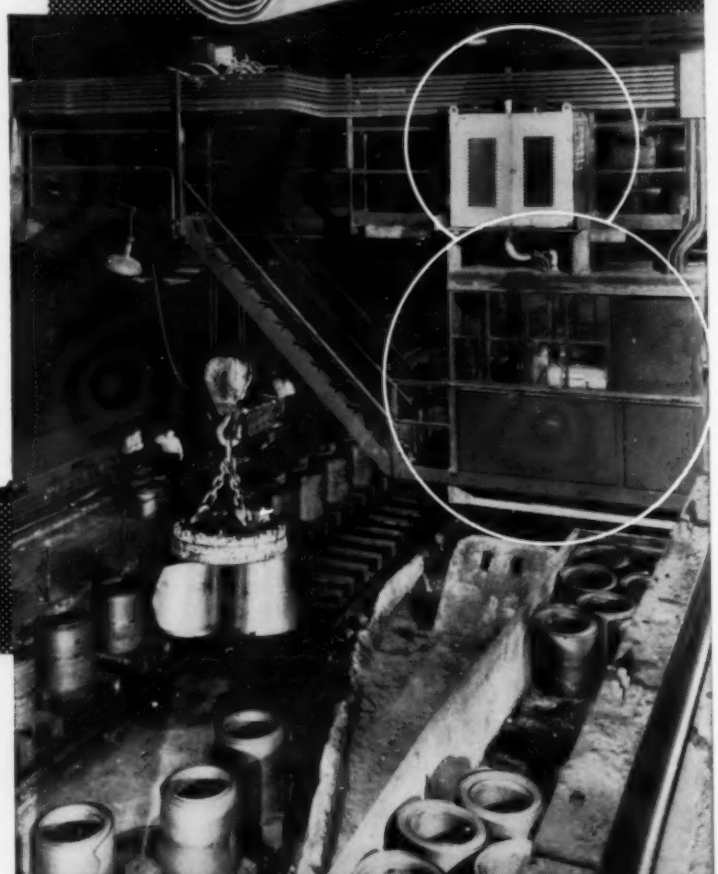
Crane operators working with hot coils of sheet steel at Jones & Laughlin Steel Corporation's Cleveland Works were subjected to ambient temperatures of 150°F . . . until a Dravo Split-Type Crane Cab Cooler was installed on the crane.

Now temperatures inside the cab have been reduced to 80-85°F, providing crane operators with healthier working conditions, making them more efficient and alert and reducing the possibility of accidents.

Because of the limited space available on the crane, the condensing section was mounted on the bridge and the evaporator section was placed in the cab itself. The two sections are joined by refrigerant piping, eliminating the need for a bulky duct system.

Dravo Crane Cab Coolers filter the air, remove dust, dirt and fumes; provide heat in winter, cool air in summer, and constant ventilation the year around. They are easily and quickly installed on any type crane with a minimum of crane down-time required.

Dravo Crane Cab Coolers are available now in both split-type and self-contained units. Write for more information—or call the nearest Dravo Office and have our representative call on you. Ask for Bulletin No. QX 1301-5



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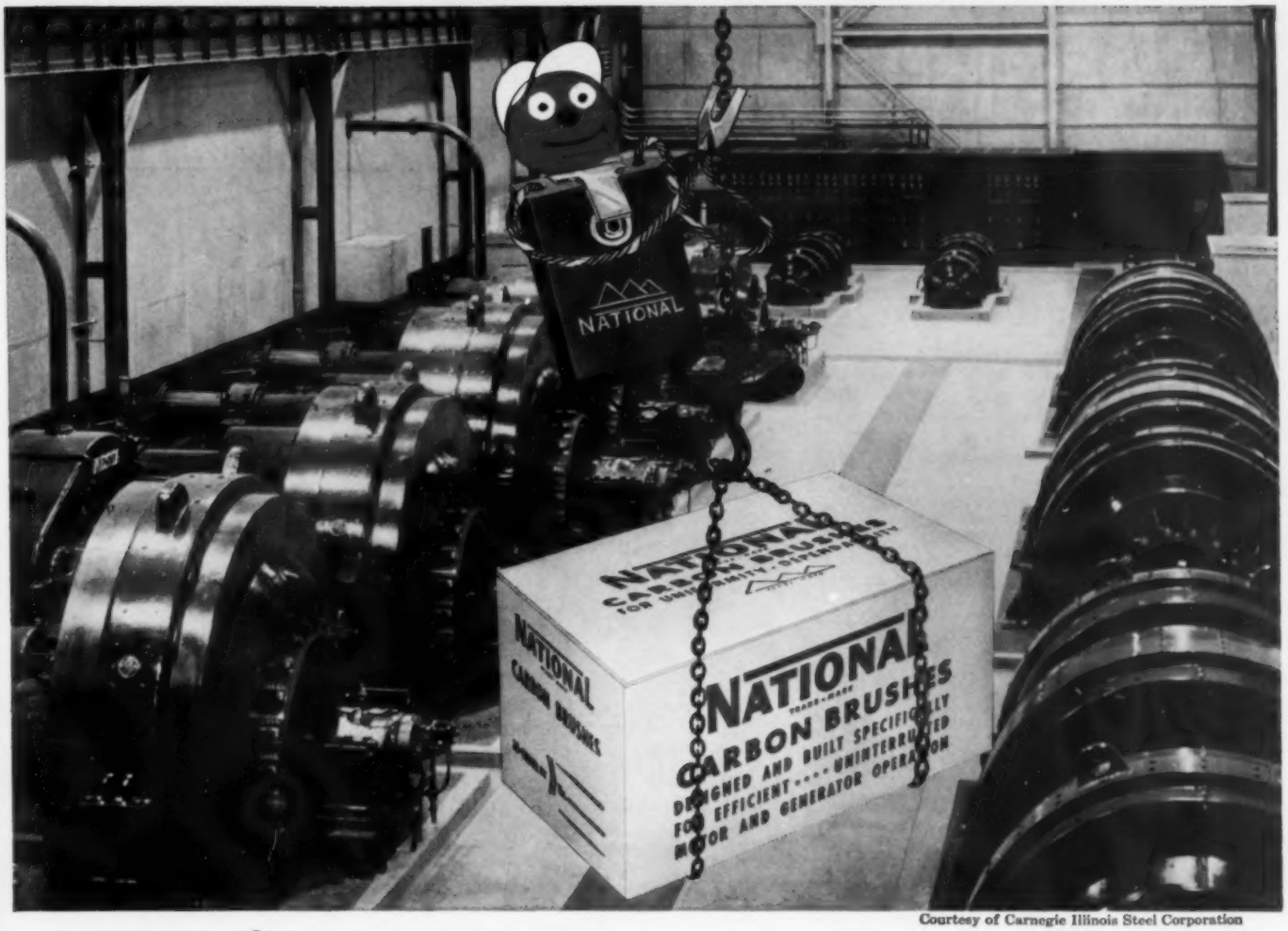

Courtesy of Carnegie Illinois Steel Corporation

KEEP 'EM ROLLING All Through the Mill with NATIONAL BRUSHES

TRADE-MARK

NATIONAL CARBON has always concentrated on *uniform* brush grades of wide-scale application. Today, there are "National" brushes to keep 'em rolling longer, more economically, *all through the mill*—from main drives to midget regulators and throughout the full range of mill-type and general-purpose motors.

Wherever it's to your advantage, *you* can standardize on certain "National" *STANDARDIZED* brushes for a high percentage of your over-all brush requirements...with consequent savings in brush cost, simplification of ordering procedure and quicker delivery.

NATIONAL CARBON representatives will gladly help you set up such a program of standards for your own plant — based on "National" *STANDARDIZED* brushes and utilizing the wide variety of Stock and Catalog items available in the "National" brush line.

HERE'S WHY "NATIONAL" BRUSHES ARE BETTER:

- **Service proved dependability**
- **Closely controlled commutation factor**
- **Minimum commutator wear**
- **Long life**
- **Uniformity from shipment to shipment**

FOR FURTHER INFORMATION, CALL YOUR DISTRICT OFFICE LISTED BELOW.

NATIONAL STANDARDIZED BRUSHES

BETTER— PRODUCT—PACKAGE—PRICE— FASTER

The term "National", the Three Pyramids device, and the Silver Colored Cable Strand are registered trade-marks of Union Carbide and Carbon Corporation

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A Division of Union Carbide and Carbon Corporation
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NATIONAL CARBON LIMITED
Montreal, Toronto, Winnipeg

News in 1940—production necessity today

ONLY a few years ago, the science of sensitive, accurate measurement was limited to laboratories. But today, this science is practiced every day in thousands of industrial plants by factory men . . . who don't have to be instrument experts.

Production men wanted to put this science to work, for they had long known that many processes would function at greater efficiency if temperature, pressure and other variables could be more accurately maintained. Although these potential benefits could be proved in the laboratory or in pilot plants, they could seldom be exploited fully in actual production.

Milestone in measurement

One of the main reasons was that existing industrial methods of measurement were not sufficiently accurate, sensitive or fast. Instruments with delicate mechanical balancing systems suffer inherent limitations . . . always require a compromise between sensitivity and ruggedness . . . and can provide only periodic measurements.

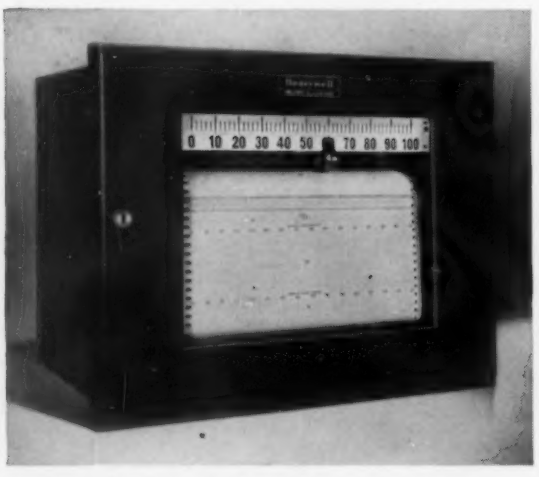
Then, in 1940, the advent of *ElectroniK* instruments swept away these limitations. By adopting an entirely new approach—electronic continuous balancing—these instruments revolutionized the concepts of industrial measurement. They placed laboratory accuracy and sensitivity at the disposal of the production man . . . with all the simplicity and ruggedness demanded by industrial service . . . *plus* speed of response never before economically practical.

Proved by years of performance

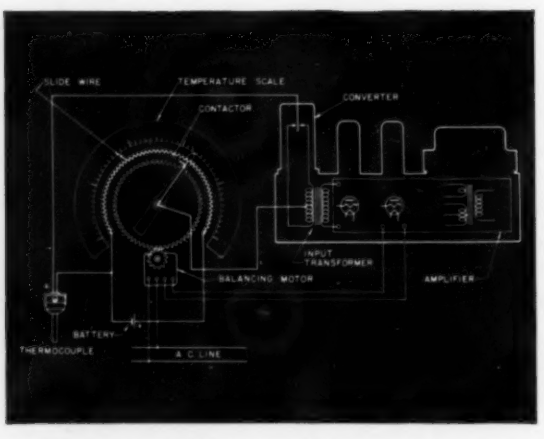
In the past thirteen years, thousands of plants have discovered almost endless applications where the superior performance of these instruments helps to improve operations. The more they learn about *ElectroniK* instruments, the more they call on them for increasingly complex tasks of measurement and automatic control.

Since 1940, the *ElectroniK* family has grown to encompass a host of new indicating, recording and controlling models . . . capable of measuring scores of different process variables . . . equipped with the most advanced types of automatic control. In anticipation of the needs of the future, Honeywell's intensive development program is bringing to readiness even more advanced equipment for tomorrow's process control problems.

Big furnaces with



A FAMILIAR SIGHT *to thousands of production men, scientists and engineers is this strip-chart ElectroniK Recorder, one of a complete family of indicating, recording and controlling instruments.*



POWER PLANT *of ElectroniK instruments amplifies a millionfold the minute electrical signals from thermocouples and other sensing elements.*

TYPICAL of today's trend to greater plant capacity is the huge sodium hydride descaling furnace which Lukens Steel Co. uses to clean hot-rolled clad sheets. For this critical operation, *ElectroniK* instruments once more were chosen to regulate vital furnace temperatures.

On load after load, the *ElectroniK* controllers hold bath temperatures exactly at the specified value . . . prevent overheating which might cause warping and under-heating which would slow production. *ElectroniK* accuracy pays dividends, in greater output and in top quality of finished sheets. And *ElectroniK* industry-proved design assures uninterrupted operation of this critical process.

Throughout the steel industry . . . applied to blast furnace, open hearth, soaking pit, reheating, annealing and other furnace control, you'll find thousands of these instruments performing with the highest efficiency.

produce better *ElectroniK* control

When you're planning new facilities, or modernizing existing equipment, plan on utilizing the proved performance of *ElectroniK* instrumentation. Call your Honeywell engineer for experienced consultation . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4464 Wayne Ave., Philadelphia 44, Pa.

WORLD'S BIGGEST *electric salt bath descaling furnace, at Lukens Steel Co., Coatesville, Pa., is controlled by* **ElectroniK** *instruments. Furnace holds 165 tons of sodium hydride and caustic soda . . . has power input of 800 kilowatts.*

● **REFERENCE DATA:** Write for new Catalog 1530—"*ElectroniK* Controllers."

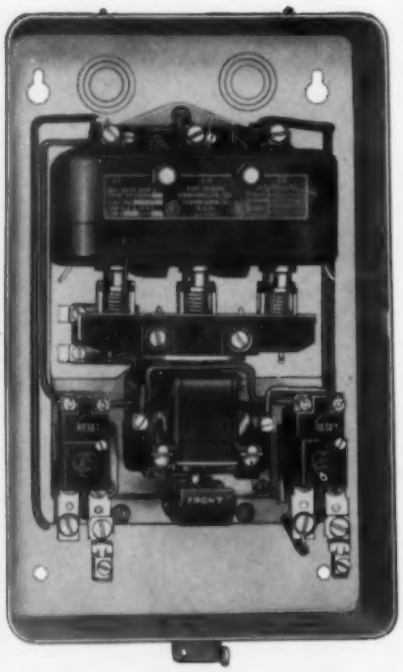
MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

a motor without Control is HORSEPOWER ON THE LOOSE!

a Motor is Plain Brute Force!

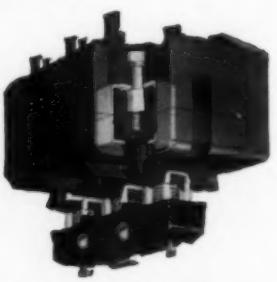
It has to be controlled. It has to be made to apply its power when and where needed.

The control starts, stops, reverses the motor. It provides overload and stalled rotor protection. It can perform other required functions, such as plugging, jogging, etc. All this, and more, is provided by CLARK TYPE "CY" AC MOTOR STARTERS.



Size 2 Non Reversing Type "CY" AC Motor Starter Cover Removed

Featuring an entirely new method of arc quenching in which the arc is constantly forced to rotate, never striking the same place twice, longer contact life is insured. A minimum of contact pitting and wear gives millions of trouble-free operations.



Phantom view Showing Arc shield

All parts are removable from the front—that simplifies maintenance!

And the overload relay, with true eutectic alloy, has 50% greater clearances than demanded by standard specifications, oversize silver to silver contacts, quick break tripping, and easily determined heater ratings. This relay has been successfully used on countless applications for over 14 years.

Magnetic blowout coils are used on all Size 2 and 3 "CY" starters.

Sizes 0 and 1 use the same general mill type construction as the larger sizes.

Cabinets to meet all industrial conditions are available for all four sizes.

You'd Better Try...CLARK type "CY"!

THE CLARK CONTROLLER CO.

ENGINEERED ELECTRICAL CONTROL • 1146 EAST 152ND STREET, CLEVELAND 10, OHIO

2 more examples of THERMIT WELDING ECONOMIES

SOW BLOCK

Replacement of this damaged sow block for a 35,000-lb. forging hammer would have been costly and time consuming — Thermit repaired it quickly and economically.

48" MILL PINION

Weeks of costly idle time were saved by Thermit Welding the 28" neck instead of waiting for a replacement.

Thermit Welding is the answer to repair problems in many different plants—for a wide variety of equipment. Reasons:

- **consistently sound welds**
- **minimum of technical skill required**
- **speedy repairs**
- **lower than replacement costs**

INVESTIGATE THERMIT® WELDING

always ready to go to work

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ARC WELDING—*Materials and Equipment* •
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The palm tree that grows in Ohio

They planted it a year ago.
Leading steel publications covered the story:

"New All-American Lubricant For Cold Rolling Operations"

That's how The Ironsides Company of Columbus, Ohio, announced the first successful replacement for palm oil.

Instead of relying on palm trees—half a world away, tin plate producers now have a "palm tree" right in their own back yard.

Palmoshield looks, feels and acts like palm oil; requires absolutely no changes in mill operation. Already most of the major tin plate mills in this country and Canada are using Palmoshield for regular mill operations or for production test runs.

. . . and grows and grows and grows!

Production records set with Palmoshield: Recently a leading steel company, over a run of 20 consecutive shifts, increased production 15% over the average output with imported oil. No additional investment, no increase in manpower, and no changes in mill operation. Yet 115 tons of steel were rolled for every 110 before. One company broke the single-shift record, and still another broke both 8-hour and 24-hour records.

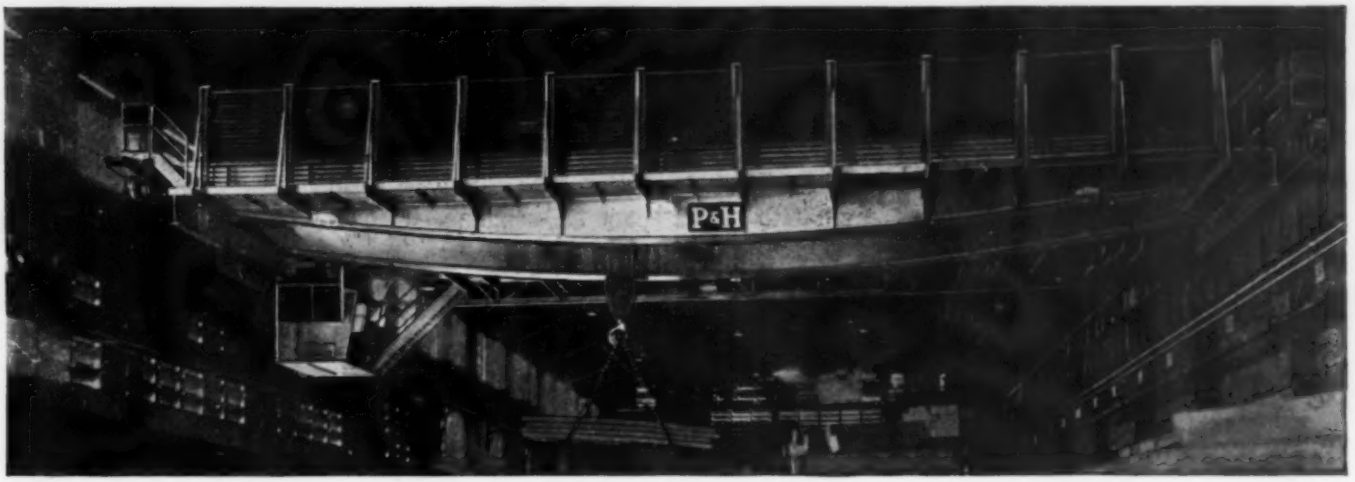
Backed by 60 years of specialization: Palmoshield is the result of Ironsides' sixty years of specialized research in the field of scientific lubrication. For your own lubricating problems, call or write The Ironsides Company, 270 West Mound Street, Columbus, Ohio.

SPECIAL LUBRICANTS and PRESERVATIVES

SHIELD PRODUCTS

IRONSIDES PALMOSHIELD

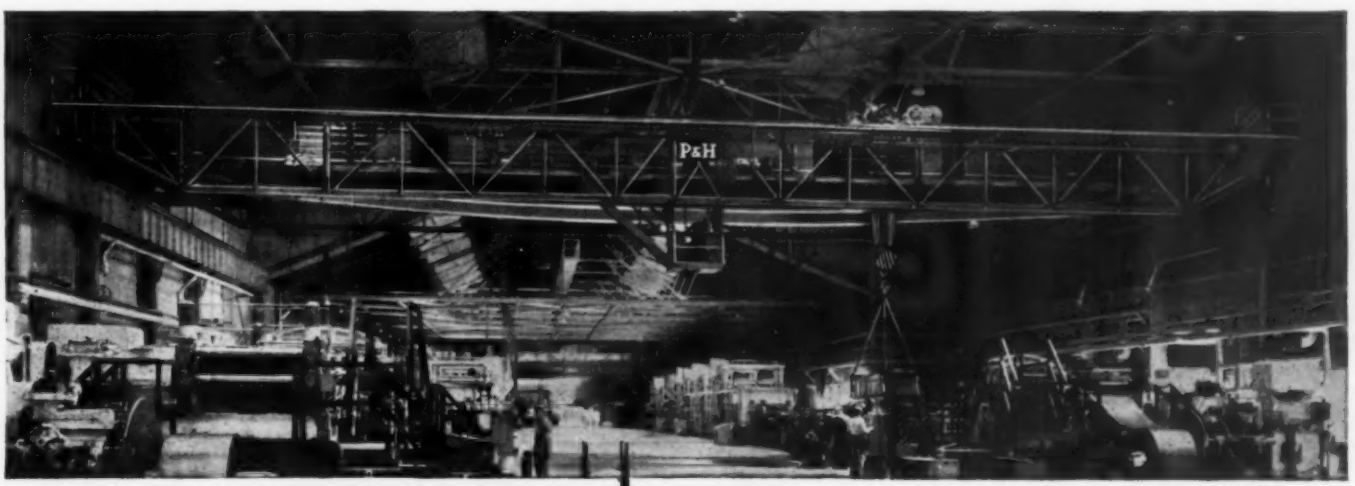
NORTH..SOUTH..EAST..WEST..EVERYWHERE!



P&H

STEEL MEN PREFER
MILL TYPE CRANES
for longer, finer service

Now, the number is well over the 2000 mark — more and more P&H Cranes serving the steel industry. There's good reason for the preference steel men put in P&H . . . and that is *performance*. It's measured in longer years of service, in lower costs, in more dependable operations. Learn more about P&H Mill Type Cranes. Write for your copy of Bulletin C-42.



P&H ***...ahead in added values***

3-Gear Case Bridge Drive — for perfectly equalized motive power.

No Open Gears at Trucks — gear reductions are fully enclosed, running in oil.

Flexible Couplings at Wheel Shafts — for smoother starts, longer bearing life.

Split Gear Cases — easier inspection and maintenance.

Large Diameter Cross Shaft — greater strength, lower torque to minimize strain.

Hoist Sheaves — readily accessible from trolley deck. All hoist gears, including drum gear and pinion, run in oil.

P&H Motors, brakes and controls available.

P&H **OVERHEAD CRANE DIVISION**

HARNISCHFEGER
CORPORATION

Milwaukee 46, Wisconsin

POWER SHOVELS • CRAWLER AND TRUCK CRANES • OVERHEAD CRANES • HOISTS • ARC WELDERS AND ELECTRODES • SOIL STABILIZERS • DIESEL ENGINES • PRE-FAB HOMES

1803-1953

Drawings from Harley's patent of 1835, acquired by Mack-Hemp. The inclined pipes give a rotary motion or swirl to the molten metal. This was the inception of the modern method of casting with this spiral motion.

THE METALLURGICAL PROPERTIES OF ALL M-H ROLLS ARE CAREFULLY CONTROLLED FOR MAXIMUM SERVICE

Mack-Hemp's one hundred fifty years of service to the metals industry

Experience and Know-How... there's a hundred and fifty years of it in every Mack-Hemp Roll; *experience* obtained from every segment of the metals industry, and *know-how* acquired by years of *doing.*

As Harley's patent of more than a century ago indicates, Mack-Hemp has always kept pace with the metal-forming industry. 1953 is a continuation of this progressive policy —the M-H Roll line is modern and complete. Whatever your rolling mill requirements, we would like to discuss them with you.

MACKINTOSH-HEMPHILL COMPANY PITTSBURGH U.S.A.

MACKINTOSH-HEMPHILL COMPANY

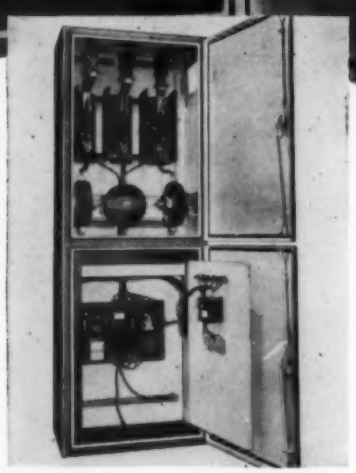
Makers of the Rolls with the Striped Red Wabblers

PITTSBURGH AND MIDLAND, PA.

MACKINTOSH-HEMPHILL PRODUCTS INCLUDE: rolls . . . steel and special alloy castings . . . completely integrated strip mills . . . heavy duty engine lathes . . . Mackintosh-Hemphill rotary straighteners . . . improved Johnston patented corrugated cinder pots and slag handling equipment . . . shape straighteners . . . end-thrust bearings . . . shears . . . levellers

choose EC&M

FOR 2300-4600 VOLT MOTORS



Two views of a 2300 volt EC&M VALIMITOR aligning-type cubicle starter with self-contained bus at top for connecting power to all the starters for this installation. Door interlock provides "*safety*" against opening disconnect switches under load.

OVERLOAD & SHORT CIRCUIT PROTECTION in a *single unit*

2-WAY PROTECTION with new EC&M Bulletin 1180-3 THERMAL-MAGNETIC Overload Relays. Instantaneous trip *magnetically* on short circuits...inverse-time trip *thermally* on overloads. Independent snap-action silver contacts for instantaneous and thermal trips help locate trouble when a shutdown occurs.

CONTINUOUS PROTECTION without blind spots is an inherent feature of EC&M VALIMITOR Starters, because the maximum fault current (KVA capability may be infinite) is limited to 25,000 KVA (steady state current) by EC&M VALIMITOR coils. Interruption of the current is by the well-known high interrupting capacity Type ZHS Contactor. No fuses to replace.

UNDER VOLTAGE PROTECTION—When voltage dips or power fails momentarily, motor will re-accelerate if normal voltage returns in two seconds or less. The contactor remains closed down to a low voltage with full spring pressure on the contacts. At about 25% control voltage, the contacts break cleanly—do not stick or burn.

WRITE FOR T9-117 REPRINT BULLETIN

E&M

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET • CLEVELAND 4, OHIO

After Amscoating with Thermalloy 4, these Piercer Guide Shoes reduced down time and kicked production up.
Composite shear blade of mild steel base metal, hardfaced with Thermalloy 4 on cutting edge. Lower view: part after machining.
Hot trimmer die and punch Amscoated with Thermalloy 4 increased service life, cut costs.

BEAT HEAT WEAR and IMPACT with AMSCO THERMALLOY 4

If you have a wear problem involving high temperatures and requiring resistance to impact, this new Amsco hardfacing electrode can save you time and money

Elevated temperatures are tough to cope with in situations involving thermal shock, metal-to-metal wear, hot gas corrosion, high temperature oxidation—especially when you need great impact resistance. Here's where Amsco Thermalloy 4 can step in and give you longer service life, and big savings in time and money.

Supplied as both a composite coated electrode for electric welding or as a bare cast rod for gas welding, both types deposit a high-carbon stainless alloy containing chromium and nickel as the principle alloying elements. In many applications, it can replace expensive nickel base alloy materials. Thermalloy 4 is packaged in 50-lb. boxes or in 10-lb. packages in 50-lb. boxes. For detailed analyses and other pertinent information, write for catalog sheet on Thermalloy 4 or contact your nearest Amsco distributor.

AMSCOATING

THE RIGHT WAY TO SAY HARDFACING

AMERICAN Brake Shoe COMPANY

AMERICAN MANGANESE STEEL DIVISION

411 EAST 14th STREET • CHICAGO HEIGHTS, ILL.

Other Plants: New Castle, Del., Denver, Oakland, Cal., Los Angeles, St. Louis. In Canada: Joliette Steel Division, Joliette, Que.
Amsco Welding Products distributed in Canada by Canadian Liquid Air Co., Ltd.

★ RUGGED

★ POWERFUL

★ EFFICIENT

A STEARNS lifting magnet moves steel mill material fast . . . to where you want it — in one simple operation. Save hand labor and time . . . turn wasteful man hours into profitable minutes with a Stearns lifting magnet. Take advantage of the extra protection you get with Stearns Heavy-Duty construction. Stearns lifting magnets are experience engineered for greatest lifting efficiency . . . at rock bottom handling costs for magnetic materials.

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STEARNS Lifting Magnets are available in standard and special sizes made to your specifications. Available in bolted or all welded construction. Write today for STEARNS Lifting Magnet literature.

MAGNETIC EQUIPMENT FOR ALL INDUSTRY 1018

STEARNS MAGNETS

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Industrial Cut Gears

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Crane Trolleys, Roller Tables, Hoists, Shears, Lathes, Bar Mills and other Steel Mill Equipment are a few of the many applications for Industrial "Durocase" Gears.

"Industrial Gear" can take care of your heaviest requirements—Herringbones up to 61" in diameter with an 18" face—Spurs up to 102" with companion Pinions, Bevels, Spirals, Worms and Worm Wheels and Mitres of all sizes, cut to exacting specifications.

Users everywhere report smooth, rugged, long life operation when "IG" Gears or "IG" DUROCASE (Steel Mill Type Gears) are on the job.

Why not consider "Industrial Gear" on the next order and note the difference in quality and service.

See how well our fully equipped plant can serve you. Write for Brochure "A Pictorial Trip Through Industrial Gear"—Bulletin No. 152-A.

MEMBER OF AGMA

Industrial Gear Mfg. Co.

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This is *PRECISION*

A-C Crane Hoist Control

15 Tons of Steel . . . handled as though it weighed a pound. The picture at the right tells the story. A walnut and wrist watch were placed side by side. The operator lowered the 15-ton, full-hook load. The walnut was cracked. Then the load was raised without the least settling action. The watch was left untouched.

That's Precision . . . precision that is attained on all cranes equipped with the new Westinghouse Load-O-Matic Crane Control. In this particular test, the load was lowered with the master switch set at the first point lower. No jogging, inching or retardation was necessary—lowering rate was smooth and steady.

The Load-O-Matic hoists and lowers *all* loads—the empty hook, light or maximum loads—at stabilized speeds. Loads can be brought to a standstill or suspended by action of the motor only.

VERNIER CONTROL PROVIDES FLEXIBILITY

Additional flexibility of operation is available with the auxiliary Vernier control. This control component is especially useful for high-accuracy spotting. For example—with full load on the hook and the master switch on the first lowering point, operation of the Vernier provides control from approximately 7% of full speed to standstill. Operator can actually float the load into the desired spot.

ASK FOR DESCRIPTIVE BOOKLET B-5417

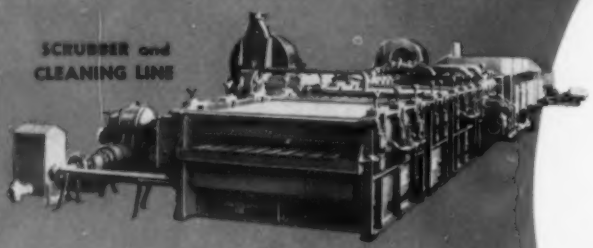
This booklet describes all the operating characteristics and features of the Load-O-Matic a-c crane hoist control. Ask your Westinghouse representative for your free copy, or write direct to: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-27015-A

YOU CAN BE SURE...IF IT'S
Westinghouse

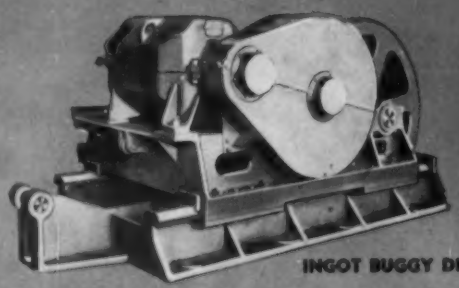
This simple test of the Westinghouse Load-O-Matic was conducted at a Materials Handling Conference and witnessed by more than 100 engineers. The full load of 15 tons was lowered at an almost imperceptible speed till it cracked the walnut. The watch was not damaged. Then the load was raised without the least settling action.

STEEL MILLS Rely on F&Y

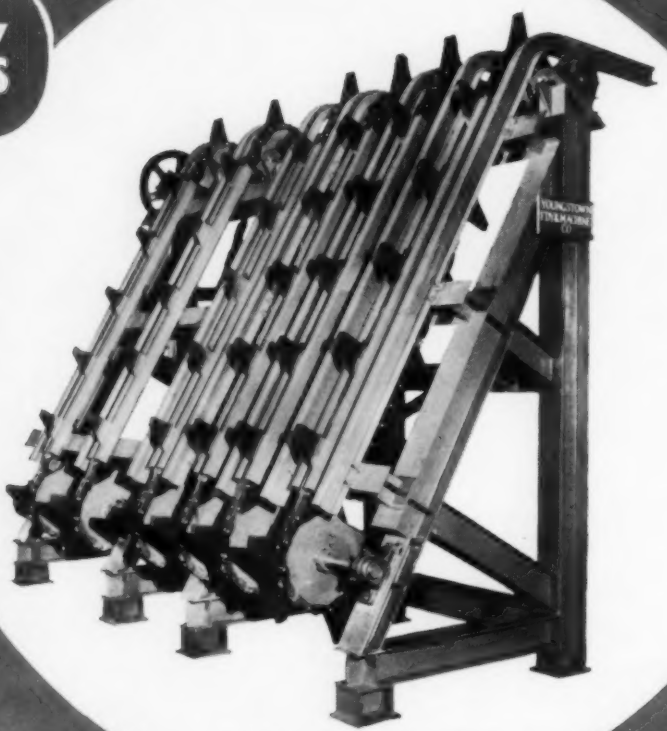
for **MACHINES, EQUIPMENT, ROLLS AND CASTINGS**



SCRUBBER and CLEANING LINE



INGOT BUGGY DRIVE



60° INCLINE BILLET ELEVATOR

Check this List for the Products You Need

- PARALLOY ROLLS (Pinch, Coiler, Tension, Steel Mill)
- HYDRAULIC SLAB AND BILLET PILERS
- STRIP AND SHEET OILING EQUIPMENT
- SHEET SCRUBBER AND CLEANING LINES
- HOT SAWS—ROCKING AND SLIDE TYPES
- HOT BEDS—COOLING BEDS—TRANSFERS
- BILLET EJECTORS—PINCH ROLL STANDS
- SLITTERS—SPECIAL SHEARS AND GAUGES
- TILTING TABLES—Traveling and Lifting Tables
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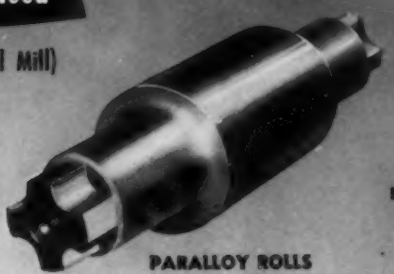

PARALLOY ROLLS

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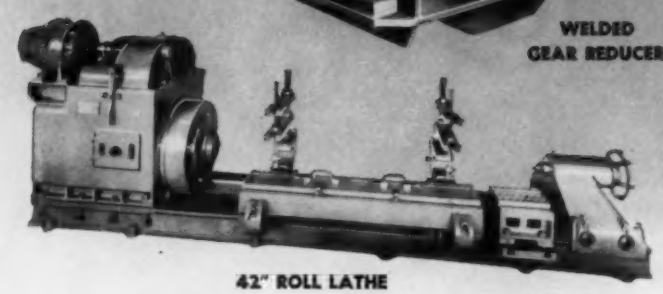


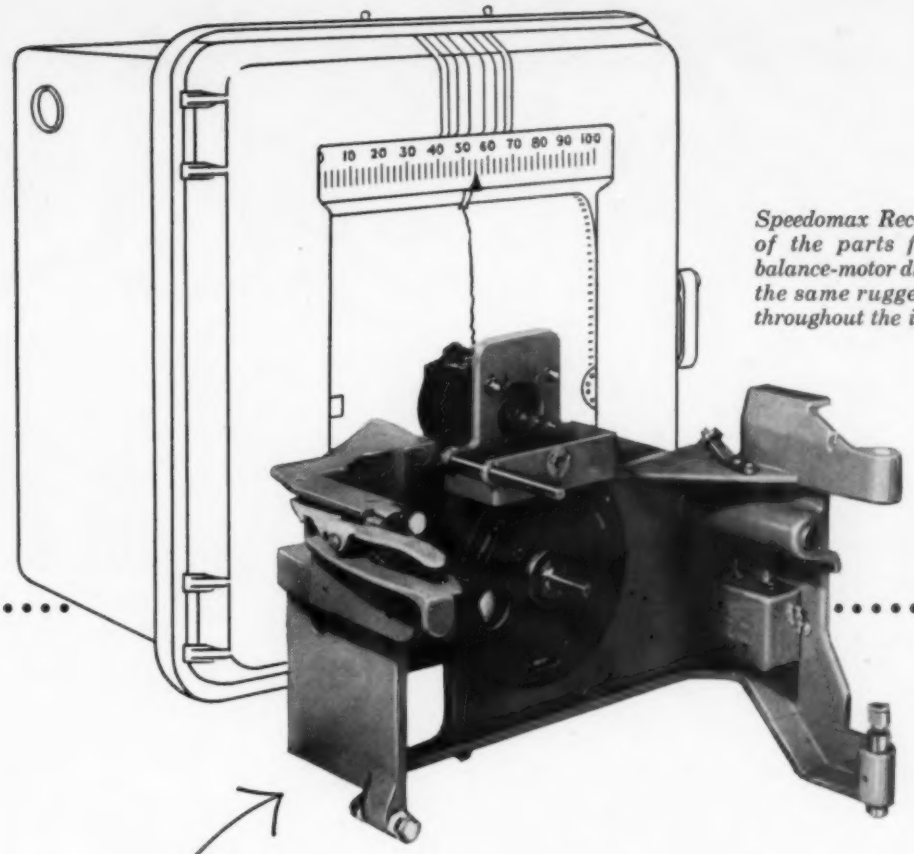
42" ROLL LATHE

The Youngstown Foundry & Machine Co.

OVER SIXTY YEARS OF SERVICE TO THE STEEL INDUSTRY

Youngstown, Ohio

6*



Speedomax Recorder and a few of the parts for its circuit-balance-motor drive. You'll find the same rugged construction throughout the instrument.

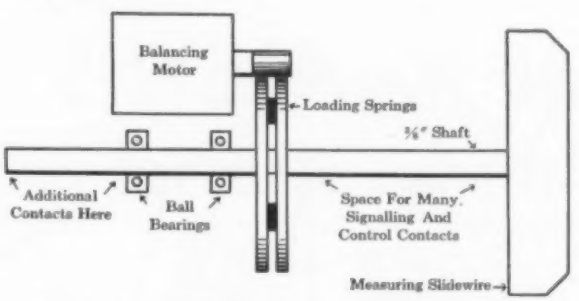
RIGID CONSTRUCTION MEANS Rigid Dependability

● When you turn a measuring or control job over to a Speedomax instrument, much of the good performance you receive is due to the strong, carefully-assembled mechanism controlled by the sensitive electronic circuits. Seasoned, time-proved mechanical design is evident as soon as you open the instrument door.

For instance, just rotate the "big" balancing-gear train with your fingers. You won't detect back-lash. The train will turn at a touch, but those two 1/8" face, spring-loaded gears are held so snugly against the pinions, in opposite directions, that they answer every tiny balancing motion in either direction. The slightest nudge from the "huge" 12-watt balancing motor therefore goes straight to the slidewire, recording and control mechanism via their common shaft. The tying of these functions to one shaft assures permanent alignment of recording, control and measuring functions.

The paper drive and some other components get their positive action in another way. They use machined, heat-treated worm gearing for snug fit and precise motion. Ability to use such designs is one of the many advantages of the instrument's ample power. Liberal use of ball bearings is another quality feature, to transmit full power, reduce routine attention and maintain operating precision.

As you look further into a Speedomax, you'll also note that many parts such as frame castings, shafts, linkages, etc., seem very large. But there's a strong reason for this seeming oversize—it prevents mechanical deflections in operation. Rigid construction gives rigid dependability.



The Speedomax Mechanism "Heart" Is Just 2 Assemblies

Why not inspect these and other evidences of quality the next time you need an electronic potentiometer or bridge. You can easily check them against the general description in our Catalog ND46(1). If you're interested in research, ask also for Technical Publication ND46(1). Address our nearest office, or 4942 Stenton Ave., Philadelphia 44, Pa.

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instruments *automatic controls • furnaces*

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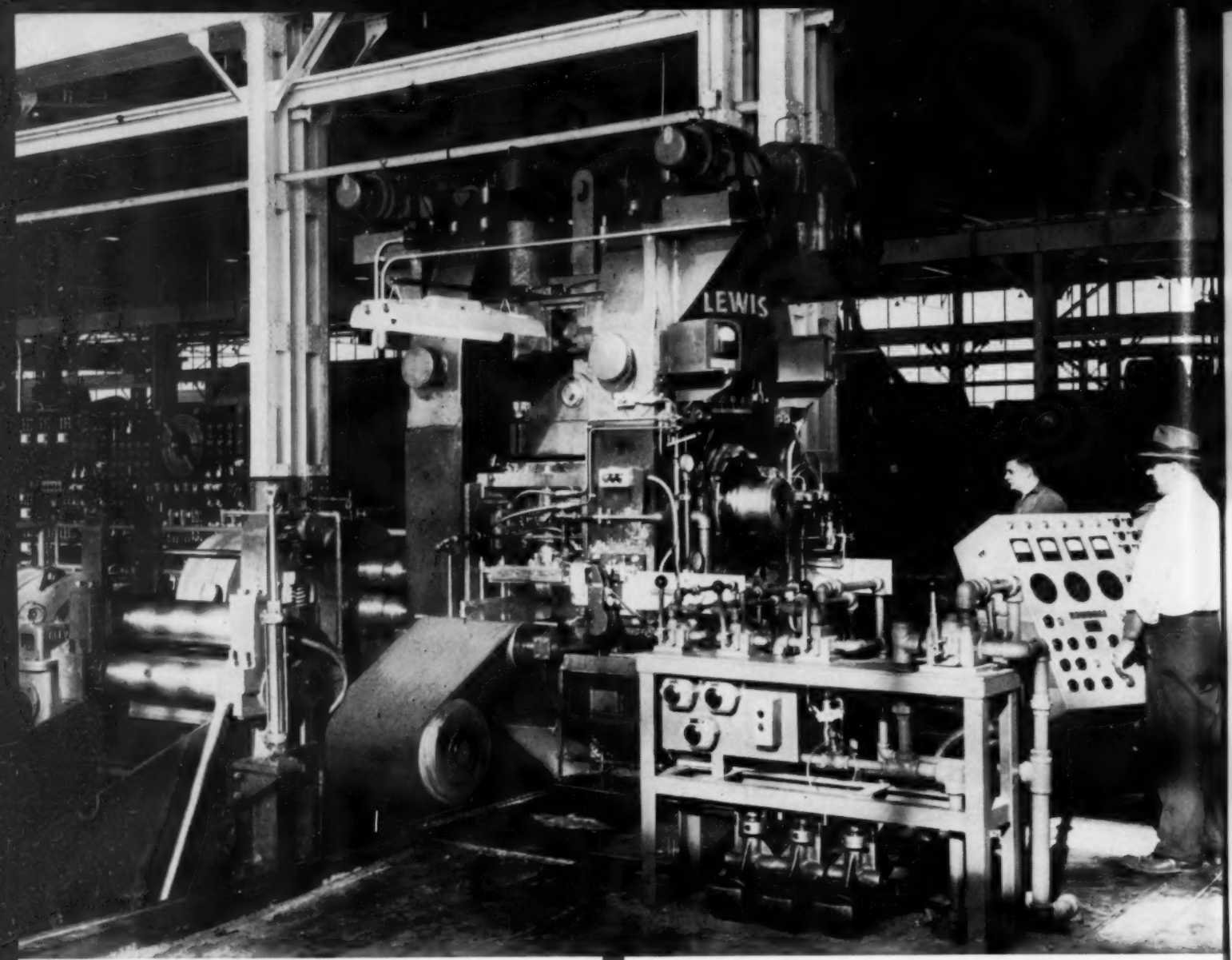

The New LEWIS

10" AND 26" X 28"

FOUR-HIGH REVERSING COLD STRIP MILL

In this high-production mill Lewis has incorporated improvements which have increased both tonnage and accuracy of gauge. Equipped with antifriction bearings, pressure lubrication and the last word in "push-button" controls. If you plan to produce more and better strip write for complete details on this new Lewis product.

BLAW-KNOX COMPANY
LEWIS MACHINERY DIVISION
PITTSBURGH 22
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BLAW-KNOX

The burner block is the heart of your fuel-fired furnace

TASIL Burner Block installed in a No. 225-4 Dual Fuel Burner of the North American Manufacturing Co., Cleveland, Ohio, leading producers of industrial fuel-burning equipment. TASIL Burner Blocks are standard equipment on North American burners for high temperature applications.

The better burner block is TAYLOR SILLIMANITE!

PRE-FIRED BURNER BLOCKS of Taylor Sillimanite (TASIL) are preferred by North American and a majority of leading furnace and burner manufacturers for high temperature applications. TASIL is specified because the block must hold original contour and dimensions. Compared to blocks made of fireclay or most other refractory materials, TASIL has superior resistance to shrinkage, cracking or spalling. TASIL further qualifies because it is inert in either oxidizing or reducing atmospheres; has higher fusion point and resistance to corrosion by most industrial slags. For longer service from your heating, annealing or forging furnaces, specify TASIL burner blocks.

In an emergency, when a burner block failure occurs at the time your stocks of pre-fired shapes are depleted, you can ram your own TASIL Burner Blocks, on the job, with one of several TASIL Ramming Mixes *engineered* for this application. Burner Blocks which may be cast or poured in molds, air dried and placed in service can also be made from TASIL Hydrocast—the hydraulic-setting castable for use to 3000° F. Data on TASIL Ramming Mixes are given in Bulletin No. 315 . . . on TASIL Hydrocast, Bulletin No. 313. Write direct, or contact your Taylor field representative, for your free copies.

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MODERN ALL-WELDED STEEL MILL CRANES
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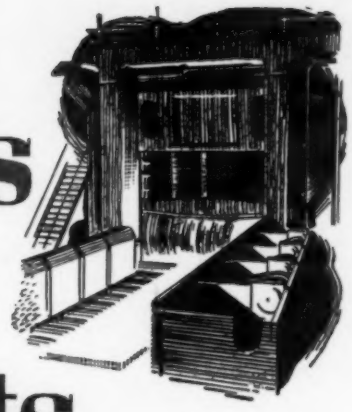
Crops and Shorts



THE May issue of the magazine "Steel Labor," published by the United Steel Workers of America, carried a tabulation showing the loss entailed by steel workers during the 1952 strike, and the gains coming to them through the increases granted to settle the strike. The figures showed the average worker lost $597.44. By deducting vacation pay and retroactive pay won, this figure was reduced to $364.88. With an average weekly increase of $10.88, this loss was shown to be more than paid off by the end of March, 1953.

Totally ignored was the fact that approximately 85 per cent of the gains had been offered by the companies and could have been had without a strike. On this basis, it will take the steel workers some 220 weeks to make up their strike loss.

▲

SPEAKING at the annual meeting of the American Iron and Steel Institute, B. F. Fairless, chairman of United States Steel Corp., predicted that the steel industry will find itself with too much capacity in a very short time. He further stated that steel prices are too low, having increased only 89 per cent since 1939 while steel wages increased 168 per cent and the prices of goods purchased by the industry increased 95 per cent.

The policy of United States Steel Corp., according to Mr. Fairless, will be to have every product carry a reasonable profit, to charge the same price to everyone, with fluid prices changed individually by producers and to be competitive.

▲

AT the same meeting, Secretary of Commerce Sinclair Weeks said the entire field of heavy industry needed fresh encouragement by government and suggested this might take the form of a change in depreciation allowances so the shorter years of obsolescence rather than the longer years of wear-out would be the standard. This would encourage owners to install modern machinery with higher productivity and lower costs, thereby benefiting the consumers.

▲

A motto card recently received says: "Keep your eye on the ball, your shoulder to the wheel, your ear to the ground — now, try to work in that position."

What's the matter with the nose to the grindstone?

THE net income of 52 iron and steel companies, representing about 93 per cent of the total steel production, totaled $529,535,178 for 1952, a drop of 22 per cent from the previous year. This decline carried the return per dollar of revenue down to 4.95 cents, the lowest since the end of World War II.

Long term debt of the companies rose to $1,447,000,000, the highest level ever reached and three times as high as at the end of World War II.

▲

A disillusioned professorial friend insists that education is the only commodity where the customer tries to get as little as he can for his money.

▲

THE iron and steel industry's payroll for the first quarter of 1953 is estimated at $828,054,000 by the American Iron and Steel Institute. This is nearly $100,000,000 higher than the first quarter of 1952, and actually exceeded the entire payroll for 1939. The average hourly payment to wage earners was $2.21.

Total employment in March was 683,100, with an average of 40.3 hours per week.

▲

THE Wall Street Journal claims that thousands of women could add years to their lives by telling the truth.

▲

VARIOUS price increases announced recently by steel producers were accepted calmly, and steel supply continues tight in spite of record production. Even conversion deals, with their high costs, continue for delivery into the third and fourth quarters. Actually, some buying might be attributed to fear of further price increases.

The pessimism of last January seems to have disappeared insofar as the third and even the fourth quarters are concerned.

▲

A corresspondent tells us that wealth may not bring happiness but it seems to bring a pleasant kind of misery.

▲

A bulletin from the Committee for Economic Development summarizes these principles for a sound government fiscal policy:

The cash budget should be balanced under conditions of high employment.

Expenditures should be reduced with the objective of permitting the presently scheduled tax reduction to take place without a deficit.

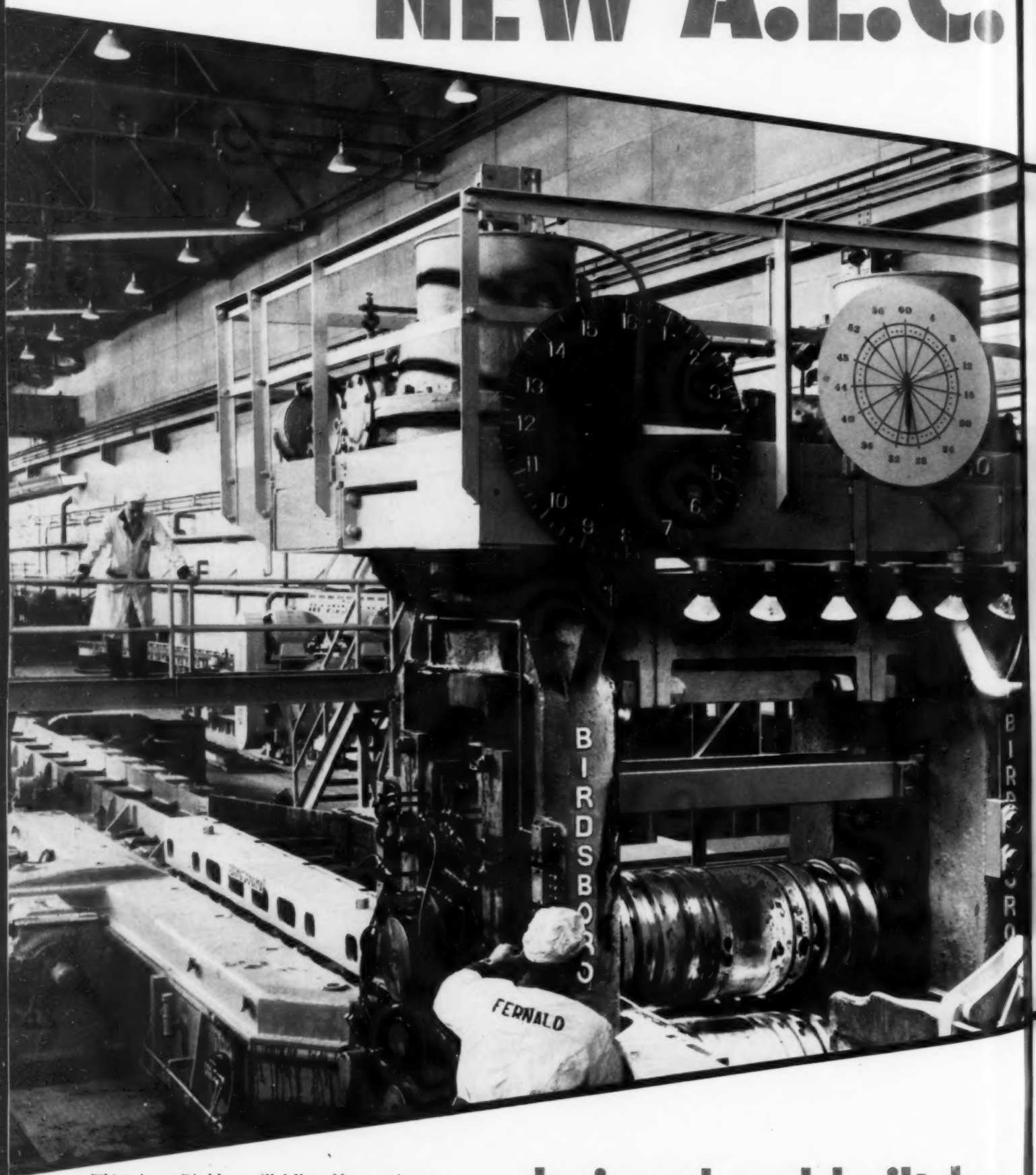
Tax decisions should be based on realistic evidence of what expenditures will be, and should be consistent with balancing the budget.

First priority in tax reduction should be given to elimination of the excess profits tax.

▲

A drink may make a new man of you, but then the new man always wants a drink.

NEW A.E.C.



This primary Birdsboro mill, followed by a continuous Birdsboro finishing mill, is used to roll uranium into bars for further fabrication into slugs used in nuclear reactors.

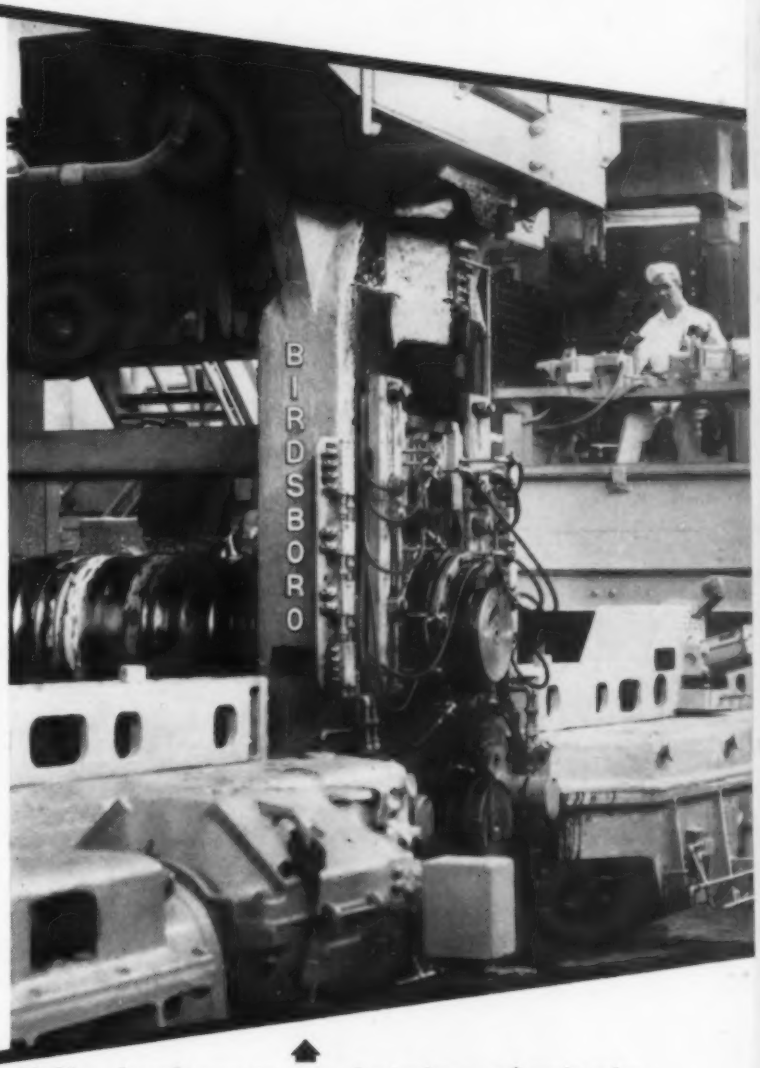
designed and built by

URANIUM MILL

goes into operation at Fernald, Ohio

Birdsboro builds first and only mill expressly designed for production rolling of uranium. New unit becomes an important link in U. S. atomic weapon output.

A. E. C.'s new rolling mill, completely designed and built by BIRDSBORO, now becomes a vital part of the Commission's new uranium production center at Fernald. This center produces uranium for use in A. E. C. fissionable materials plants elsewhere. BIRDSBORO is proud of the prominent role it played in making the new mill possible. It was an exacting job and there was a host of engineering problems to be solved before the mill was completed. Month after month was spent in research and experimentation on the tricky job of rolling uranium ingots into bars. BIRDSBORO started from "scratch", designed and built the mill completely . . and today it is in steady, high volume production.



Birdsboro brought over 58 years of experience and engineering skill to bear on the new A. E. C. mill . . . the same experience and know-how the Company offers you in your search for better, lower-cost mill rolling operations.

UNITED STATES
ATOMIC ENERGY COMMISSION
NEW YORK OPERATIONS OFFICE

April 3, 1953

Mr. J. M. McCauley, President
Birdsboro Steel Foundry & Machine Company
Birdsboro, Pennsylvania

Dear Mr. McCauley:

It is with pleasure that I commend Birdsboro Steel Foundry & Machine Company, and in particular the Engineering Department of its Rolling Mill Division, on an outstanding performance in designing and manufacturing a special mill to roll uranium for the United States Atomic Energy Commission. Not only was this an extraordinary achievement in terms of speed, but the costs of the mill have been held well in line with the original estimates which were projected from quite sketchy information. This is indeed a credit to your Company, and bespeaks the high ability of your staff. . .

Again I wish to thank and commend you, and through you the Birdsboro staff, on an excellent job.

Very truly yours,

H. B. Fry
Manager

M:HBF:ab

". . . an extraordinary achievement in terms of speed . . . a credit to your Company, and to the high ability of your staff."

BIRDSBORO

MM 29-53

BIRDSBORO STEEL FOUNDRY & MACHINE CO., BIRDSBORO, PENNA.

STEEL MILL MACHINERY

Offices in Birdsboro, Pa. and Pittsburgh, Pa.

• ***designers and builders of:*** Steel Mill Machinery • Crushing Machinery • Hydraulic Presses • Rolls • Special Machinery • Steel Castings

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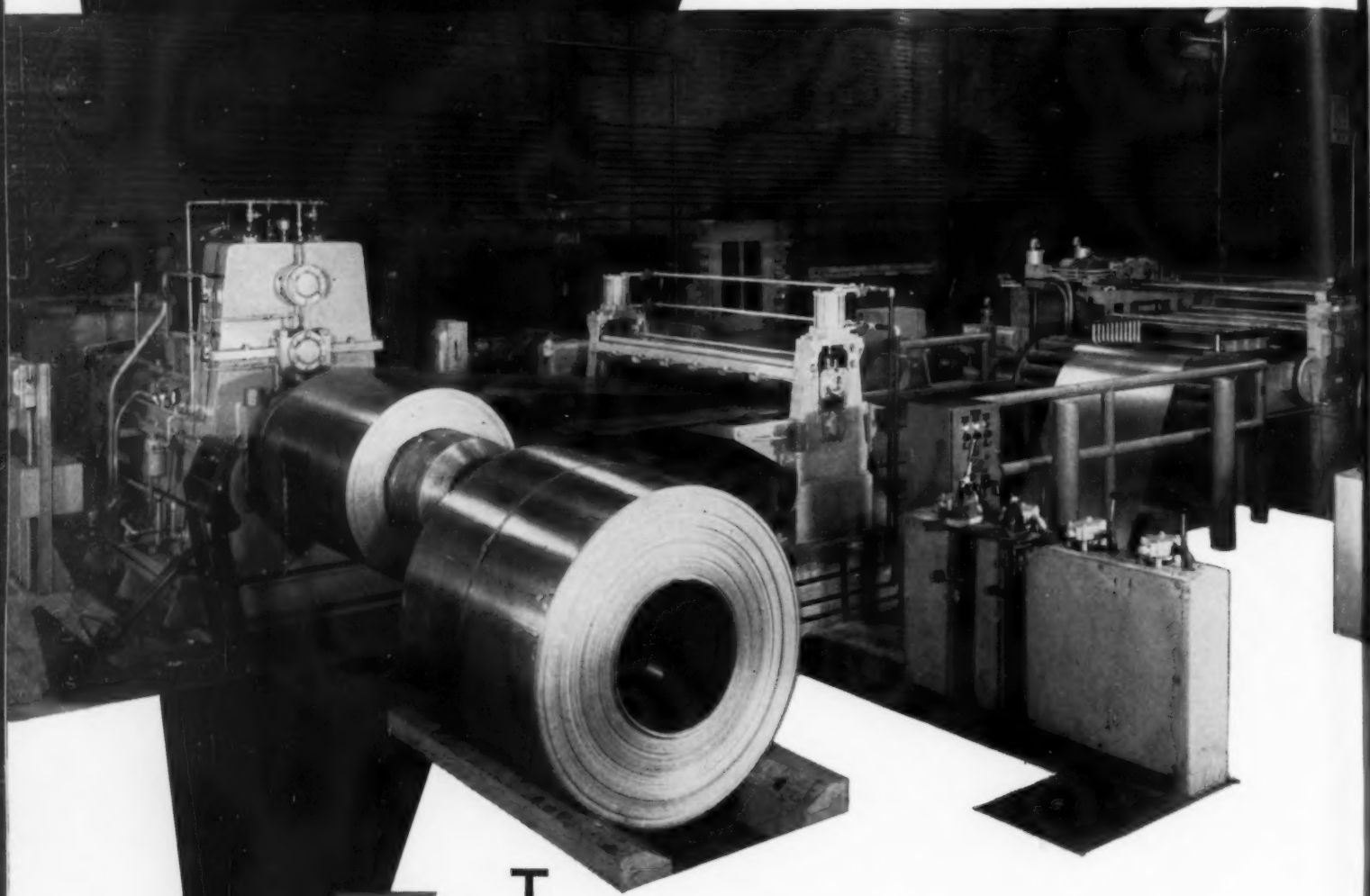
Warren, Ohio . .



THE Wean Engineering Company, Inc., Warren, Ohio, is a recognized specialist in the design and installation of sheet, tin and strip mill equipment. The expert knowledge and trained imagination of one of the world's most noted steel mill engineering firms is at your service when you specify Wean — whether the job calls for a single piece of equipment or a complete design of an entire line.

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Pittsburgh, Pa.

Iron AND Steel ENGINEER

JUNE, 1953 VOLUME XXX NUMBER VI

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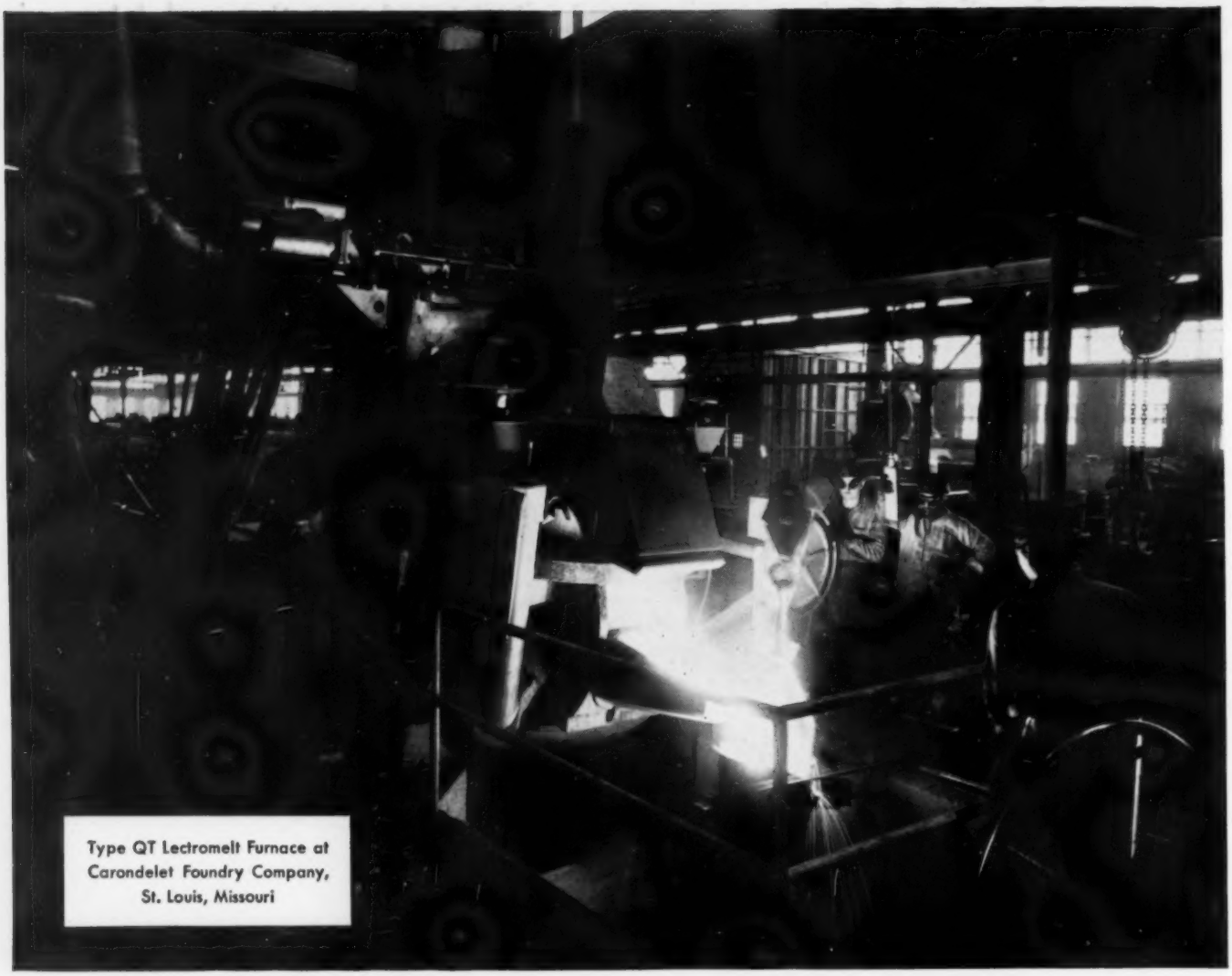

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WHEN YOU MELT... MOORE RAPID *Lectromelt*

*REG. T. M. U. S. PAT. OFF.

By HAROLD H. WARNOCK, Superintendent, Strip and Bar Mills, Republic Steel Corp., Youngstown, Ohio

DESIGN AND PRACTICES OF THE SEMI-CONTINUOUS STRIP MILL

. . . . the semi-continuous strip mill described is an economical solution to a particular need . . . . production runs over 100 tons per hour . . . .

▲ THE 48-in., four-stand semi-continuous strip mill at the Youngstown plant of Republic Steel Corp. was designed and engineered by using a combination of both existing and new equipment and is a good example of what can be accomplished in modernizing operations with a minimum of capital expenditure.

Plans were laid in the year 1945 for revamping the existing 84-in. plate mill and installing equipment necessary to produce light gage flat rolled product. The purpose was twofold. Youngstown's prime interest is centered in tubular products and the single stand plate mill was unable to satisfy the demands for increased tonnage of flat rolled needed for pipe.

The skelp produced on the single stand 3-high mill had several defects that are common to 3-high plate mills. The surface was rough with some rolled in scale pits and scratches caused by roughing and finishing on the same set of rolls. The gage was not uniform, and the bar produced always carried a heavy center that was 0.008 to 0.018 in. heavier than the edges. This center was caused by the spring of the mill with no modern back-up rolls or oil sealed bearings, and wear on the middle roll. The skelp produced on the single stand 3-high was often badly cambered and caused trouble at the pipe mills in slitting, forming and welding.

The second reason for building the new mill was demand for hot coiled stock for our own cold reduction mills and the valley market.

Furnaces — Heating capacity for this mill is supplied by three small triple-fired furnaces, hearth size 40 ft × 14 ft, gas-fired with a capacity of 25 net tons per hour each, and one new large triple-fired furnace with a hearth size of 78 ft × 18 ft 6 in. The latter furnace is equipped with both oil and gas burners, and will heat 80 net tons per hour with full hearth coverage. The total heating capacity of all four furnaces amounts to approximately 155 tons per hour.

Furnace tables — Existing furnace tables were used with no changes made in design other than a long range program of installing roller bearings on the necks.

Roughing mill — The 84-in. 3-high universal plate mill was left intact and is used as a breakdown mill for the new unit. Top and bottom rolls are 32 in. in diameter with a friction driven middle roll 23½ in. in diameter. The mill is equipped with driven vertical edging rolls on the entry side of mill. Tilting tables on front and back of mill deliver the stock to the rolls. The mill is driven by a 3500-hp d-c motor with a range of 60 to 125 rpm and is operated at 115 rpm which gives the roughing mill a delivery speed of 615 fpm. The mill's rolls run in water lubricated fabric bearings. The middle roll lift is activated by hydraulic water of 500 psi. Descaling sprays of 1200 psi are installed on the delivery side of the mill.

Approach tables — Existing tables and control boards were modified to conform with delivery speed of roughing mill. The total distance between the centerline of 3-high roughing mill and No. 1 stand, 4-high is 209 ft 3½ in.

Up-cut shear — An up-cut shear is located 26 ft 8½ in. ahead of No. 1 4-high mill restricting the maximum length of bar going to the 4-high mills to 182 ft 7 in. The shear was installed to crop the front ends of bars being rolled into bands and flat cut stock.

Descaler — Between the up-cut shears and the No. 1 4-high mill, is located a descaling cabinet consisting of twin sets of top and bottom sprays with 1200 psi pressure. A twin set of motor driven pinch rolls help to pinch the bar into the first 4-high pass and also act as a water trap to eliminate flooding the entire length of bar with water.

Finishing train — The finishing mill consists of three stands of 4-high rolls. Back-up rolls are 38 in. in diameter, 48 in. long, and are equipped with oil flooded bearings. No. 1 stand is a heavy duty mill equipped with work rolls, 18 in. in diameter, and 48 in. barrel length. The work rolls of No. 2 and No. 3 stands are 16½ in. in diameter with 48 in. barrel length. All three stands have roller bearings installed on the work roll necks. Each stand is furnished with selsyn type roll

opening indicators and hydraulic roll changing rig for the back-up rolls. Roll cooling water is supplied from a 1500 gpm pump at 400 psi.

Chutes — loopers — guides — Cast and welded steel entry guides for all three stands are provided with motor operated top side guides, allowing quick changing of sizes. Loopers between mill stands are torque motor operated and arranged to loop up. Entry and delivery guides are provided with motor operated pull backs for convenience in roll changing.

Drives—The three 4-high stands are driven as follows:

No. 1 stand, 2500 hp, 3.81 to 1 drive ratio, 59 to 118 roll rpm and 278 to 556 fpm strip speed.

No. 2 stand, 2500 hp 2 to 1 drive ratio, 112.5 to 225 rpm with 486 to 972 fpm strip speed.

No. 3 stand, 2000 hp direct drive, 150 to 375 rpm and 648 to 1620 fpm strip speed.

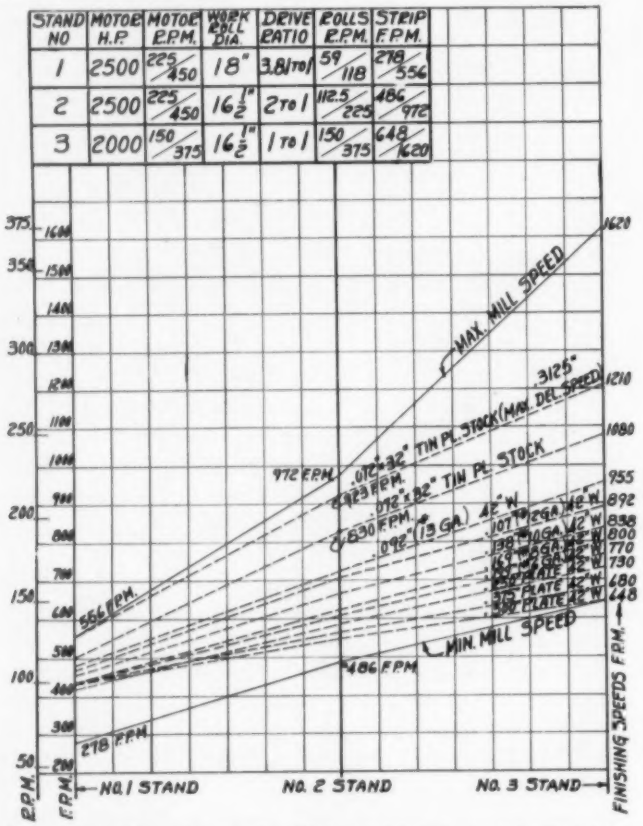


Figure 1 — Speed cone for 48-in. 4-high hot strip finishing mill.

Rotary shear — A rotary flying shear is located 13 ft from the center line of the last pass. This shear is used for cutting skelp to length and for removing back crop of coils. The shear is drum type and has a capacity for cutting skelp ½ in. thick by 42 in. wide at 1600 F at mill speeds up to 1600 fpm. Length cutting range of shear is from 33 to 54 ft. The shear is driven by a twin motor accelerating and power drive, and electric synchro-tie to synchronize shear with speed of finishing stand. Operating experience has shown that it is advantageous to cut the front crop from stock at the up-cut shear and set rotary shear to just miss the front end of the first cut. This practice eliminates the necessity of handling a front crop on delivery tables, pinch rolls or piling bed.

Hot runout table — The hot runout table which is located between the rotary shears and the up-coiler is 81 ft long, and consists of individually driven rolls, 10 in. in diameter, on two foot centers with cast iron apron plates provided between rolls. At the coiler end, the table is equipped with motor and air-operated side guards. The guards are pre-set for strip width with clearance through left and right hand screws and then adjusted for exact width by air cylinders. Selsyn indicators show openings between side guards. A section of the table is equipped with cooling sprays of 400 psi water pressure.

Piler pinch rolls and piling bed — The hot runout table is extended under the coiler to the piler pinch rolls located 11 ft 3 in. west of the up-coiler. The piling bed is a car type piler and will handle two piles of cut length skelp up to 54 ft long. The piler car is moved sideways on rails by a motor driven variable throw crank. This arrangement necessitates the moving of one row of stakes for each pile when changing to different widths of skelp. Air operated cylinders to push skelp in line are placed on both sides of the car piler. Skelp from the piler is handled direct to storage by an overhead crane, using a spreader bar equipped with "C" hooks.

Up-coiler — The up-coiler is located 81 ft west of the rotary shears and is the driven mandrel type. The coiler is equipped with an air operated expanding mandrel, 27 in. in diameter, and 48 in. long. Arranged around the mandrel in pairs are eight alloy iron wrapper rolls 11 in. in diameter and 54 in. long. Each pair of wrapper rolls is supported on hinged arms which are operated in unison by air cylinders acting through levers and links. The entry and delivery pair of wrapper rolls are motor driven. The coiler is designed to coil strip 14 to 42 in. wide to a maximum weight of 10,000 lb and a maximum thickness of $\frac{3}{16}$ in.

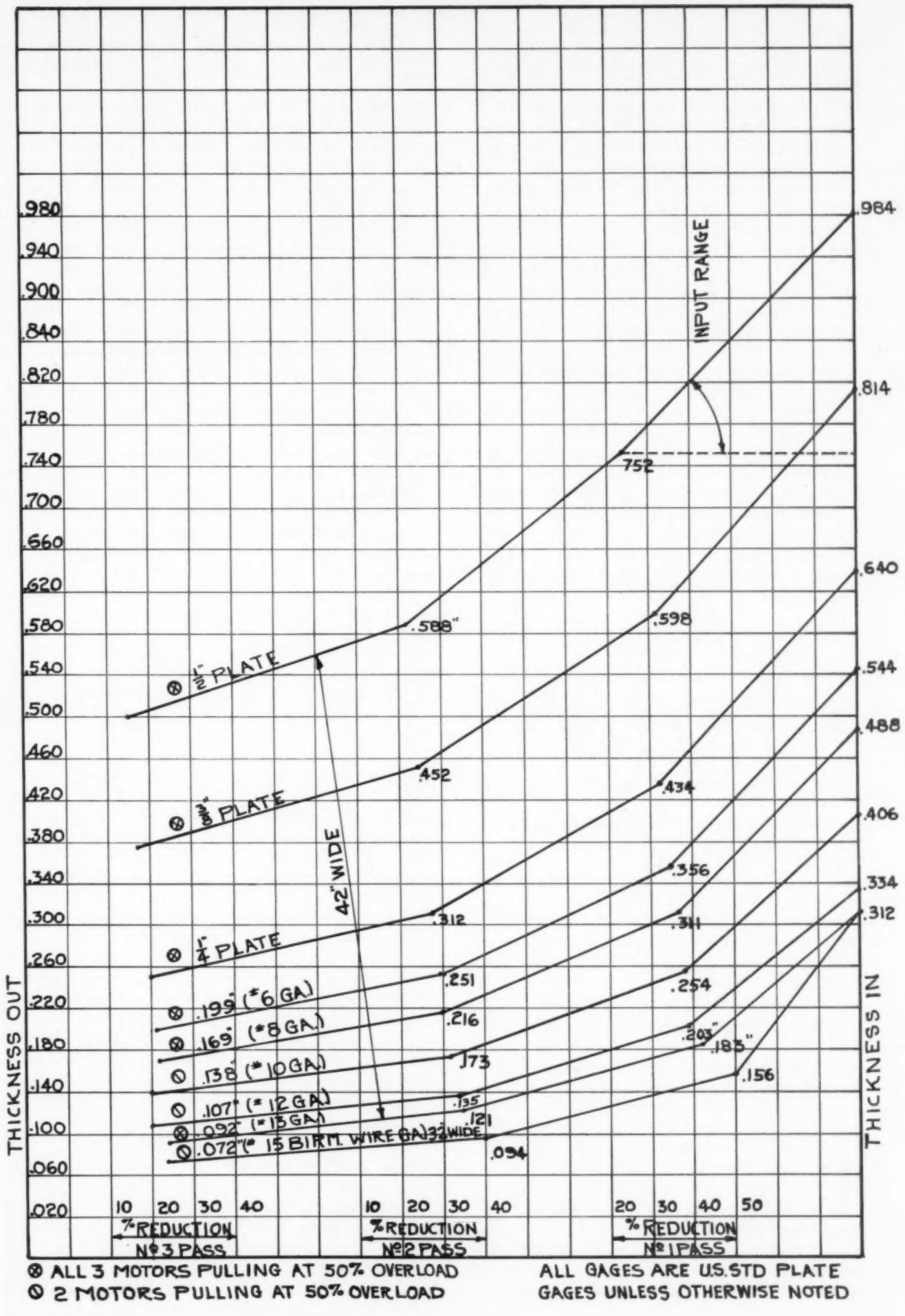
Reel unloader — coil conveyor — The reel unloader receives the coils when pushed from the mandrel and deposits them on edge on coil conveyor No. 1. This conveyor is 20 ft long and is a chain type conveyor with a speed of 15 fpm and deposits the coils on the right angle transfer. Coils are moved from the right angle transfer to the coil storage building by a chain type conveyor 160 ft long operating at a speed of 4 to 12 fpm. Coils are moved from the conveyor by magnet.

Operations — The scheduling of this mill has presented some problems. Slabs are charged direct from railroad cars to the furnaces as there is no room for slab storage at the mill. Rolling schedules are planned one week in advance and slabs must be conditioned and loaded in rolling sequence.

Slabs for cut skelp are provided in widths of 14 to 42½ in. and 3½ to 6½ in. in thickness. Roughing operations consists of breaking down slabs in 7 to 13 passes dependent on slab thickness and finished gage required. Length requirements of cut skelp range from 33 to 52 ft and slabs are provided to give a maximum number of cut lengths finished. Slabs are edged on first, third, fifth and seventh passes.

The rolling of coils in sheet gages has developed the following practice. Limiting the number of 4-high finishing stands to three definitely limits the minimum thickness to be finished to 0.072 in., because it is not practical to rough down to less than 0.312 in. ($\frac{5}{16}$ in.) on the 3-high. The maximum size of coils will always

Figure 2 — Chart shows passes for 48-in., 3-stand, 4-high hot strip finishing mill. Stands No. 1 and 2 are driven by a 2500-hp, d-c motor and stand No. 3 has a 2000-hp, d-c motor.



be limited by the distance between the roughing stand and the finishing stands.

Therefore, for 15 gage and heavier, 32 in. wide and under, slabs 3¼ to 4½ in. thick are provided. Soaking temperature on furnaces is preset for 2400 F and slabs are approximately 2350 F as discharged from the furnaces. Maximum reduction permitted on the roughing mill is ⅝ in. per pass and slab is reduced in seven to nine passes to approximately 0.312 in. thick. The temperature of bar at the entry of finishing stands is approximately 1750 F and reductions of 50, 40 and 20 per cent are used in the finishing stands.

Straight rolls are used for the rolling of all flat cut skelp and work rolls are changed approximately every sixteen to twenty hours. For coiled material, rolls are crowned with a flat crown on top roll only. A twenty thousandths (0.020 in.) crown is ground on top roll and then a 20 in. wide flat spot is ground from center line of rolls.

Rolls are changed approximately every four to five hours, or about 400 to 500 tons of production per dressing. Back-up rolls are changed every two weeks, or approximately 30,000 to 35,000 tons per dressing.

The successful coiling of bands free from telescope has been accomplished by maintaining tension on the strip between the mandrel and the last finishing stand. Mandrel deflection due to heat has been corrected by water cooling the center of the mandrel, and by crowning of the wrapper rolls.

A bank of water sprays installed on the runout table with 400 psi water cools the bar prior to coiling on the up-coiler.

The average production of this unit amounts to over one hundred tons per hour.

DISCUSSION

PRESENTED BY

C. J. KLEIN, Vice President in Charge of Engineering, Weirton Steel Co., Weirton, W. Va.

HAROLD H. WARNOCK, Superintendent, Strip and Bar Mills, Republic Steel Corp., Youngstown, Ohio.

JOHN L. YOUNG, Vice President in Charge of Engineering, United States Steel Corp., Pittsburgh, Penna.

MORRIS D. STONE, Manager Development, United Engineering and Foundry Co., Pittsburgh, Penna.

C. J. Klein: At Weirton we do not have a mill of this type which would provide us with operating information, and I would like to ask the following questions about the operation of this mill:

1. How are the slabs handled from cars to the furnace?
2. The 3-high mill has 84-in. long rolls and the maximum width slabs are 42½ in. Is it necessary to do any spreading of the slabs for final strip width of the 48-in. mill, and if not is an outlet provided for wide plates that they no doubt roll on the 3-high mill?
3. Is it necessary to treat the bearing water for the 3-high mill?
4. How heavy is the center of the strip leaving the 3-high mill? What is the center of the finished strip, say on the following gages, 0.072 in., 0.125 in. and 0.312 in.?
5. How do the edges of the strip as now rolled compare with the edges on the original mill? Are all edges sheared before using?
6. How close to finished width do the vertical edging rolls hold the strip?
7. What type of rollers are used for the hot runout table from the mill to the piler?
8. If a complete new installation were being made, would you prefer a 2-high reversing Universal mill stand and a 4-stand, 4-high finishing train if the predominate product was in the lower gage ranges which now can be rolled on your mill?
9. Can piles of strip be taken out on either side with the "C" hook crane attachment? Is the piler of the elevating type? What is the maximum weight and height of the pile? What is the average temperature of the steel going into the pile?
10. Does the up-coiler or piler limit the maximum tonnage that the mill can roll on some of the finished gages?
11. The four heating furnaces have a rated capacity of 155 tons an hour, and you stated that the average production is 100 tons an hour, do you have an excess of heating capacity?

Harold H. Warnock: In answer to the first question, slabs are handled by magnet direct from the cars at the charging skids at the charging end of the furnace.

The 3-high mill has 84-in. long rolls and the maximum width slabs are 42½ in. It is true that we have an 84-in. roughing mill where actually we only need 48 in. Prior to the installation of the new unit, we rolled wide plates to 72 in. wide, but with the installation of the new unit we have no method of handling plates wider than 42 in. so actually we have 42 in. of roll barrel that is never needed.

We do not treat the bearing water for the 3-high mill, other than to strain it on rotary self cleaning strainers.

We change the 3-high mill provided we are rolling light gage coils on about eight to ten thousandths center. This change corresponds usually with the same change of 3 stands on the finishing mill. In other words, approximately every four hundred to five hundred tons we will change the middle roll on the roughing mill and all three stands of work rolls on the finishing. Occasionally it is necessary to change only No. two and three, or even No. three.

We roll very little 0.125-in. gage, most of our gages are tinplate bands, 0.072 in. thick, and we will start out with a fairly flat bar, within 0.002 in. at the center, and when we are up to 0.008 in. we will change the mill.

On 0.312 gage, we roll a lot of skelp which is finished 0.312 in. Rolls are changed on 0.010 in. center.

The 0.125-in. gage, I would say would be somewhere between the 0.072 and the 0.312 in. gage.

The edges of the strip as now rolled are very comparable with the edges on the original mill, because there has been no change whatsoever in the practice on the roughing end of the mill. We also do not shear any edges before using.

C. J. Klein: Do you slit any stock for skelp?

Harold H. Warnock: No, in other words the skelp necessary to feed three electric weld mills is also pro-

duced on this mill. The sizes range from 2⅜-in. tubing to 16-in. outside diameter line pipe. Depending on the outside diameter ordered by the electric weld mills, the finished width is rolled on the mill in accordance with what is ordered.

In answer to the question, how close to finished width do the vertical edging rolls hold the strip, the answer to that is not close enough. However, plus or minus ⅛ in. is our tolerance. At the present time we are attempting to roll coils for our continuous weld tube mill and the tolerance required on that operation is plus or minus $\frac{3}{32}$ in.

In answer to the seventh question, the rollers used for the hot runout table from the mill to the piler are alloy iron rolls.

C. J. Klein: Are they keyed or cast to the shaft?

Harold H. Warnock: They are cast to the shaft. We have had no difficulty, and no maintenance problems, and the mills have been in operation for a little better than five years. We have had some replacement, but nothing unusual.

On the eighth question, if a complete new installation were being made would you prefer a 2-high reversing universal mill stand, and a 4-stand 4-high finishing train if the predominant product were in the lower gage ranges which now can be rolled on your mill. The answer to that is yes. I would prefer a 2-high roughing or possibly even a 4-high reversing roughing stand and certainly it would be much more advantageous to have four stands finishing rather than three stands, because as I pointed out in my paper, our coil weights are limited at the present time, due to the fact that the distance between the roughing mill and the finishing mill is fixed. If we had four stands of course, it would be possible to finish on a roughing mill with a heavier bar which would make an increased coil weight on the finishing end.

The piles of strip can be taken out on either side with the "C" hook crane arrangement, however, we take it out from the same side. It is open on the inside on one side of the pocket, and on the outside of the other side which allows us when we have the "C" hook in a fixed position, to go in and remove on both sides of the piler.

On the maximum weight and height of the piles, we handle a 60,000-lb lift and we pile approximately 24 to 30 in. high.

On the average temperature of steel going onto the pile, we make no attempt on our average product, which is grade A skelp for grade A pipe, Grade B, J 55, and H 40 casing grades, to cool beyond the finishing temperature. I would say that our average temperature finished on gages from 0.250-in. gage and up is in excess of 1700 F.

C. J. Klein: Do you spray cool that?

Harold H. Warnock: We spray cool that. However, we do roll considerable 0.125-in. gage and 0.134-in. gage, 0.140-in. gage cut length skelp for pipe. The piling of that in 50 to 52-ft lengths presents some problems, also.

On this type of product, we use more water, more of the 400-psi water on the runout table so the bars are as stiff and chilled as possible in order to pile.

On the last question, the piler does not limit the mill finished gage. As much as 160 tons an hour have been rolled on specific orders. The upcoiler does limit the production of the mill to approximately 110 tons an hour and the mill has never rolled more than that on coils.

C. J. Klein: Is that due to the changing of the coils and the time lost in its ejecting?

Harold H. Warnock: It is due to the handling of the coil strip from the mandrel.

Harold H. Warnock: That is right. The four heating furnaces have a rated capacity of 155 tons an hour, and the average production is 100 tons an hour. On 25 to 30 per cent of the product rolled there is an excess in heating capacity, but on other products there is not enough. The mill can roll much more than 160 tons in some sizes, but the average production takes in coils and strip from 14 in. to 42 in., and slightly in excess of 100 tons per hour.

John L. Young: Do you roll coils for your continuous weld mill on this semi-continuous hot strip mill?

Harold H. Warnock: No, not for our continuous weld mills.

John L. Young: How and where do you roll your strip for the continuous weld mill, or do you slit wider strip to the proper size for welding?

Harold H. Warnock: Do you mean, are we rolling coils for our continuous weld mill?

John L. Young: Yes, to actual width.

Harold H. Warnock: We are attempting to roll coils for the continuous electric weld mill to width. However, we are not doing it at the present time. Those coils are rolled on another mill, but we are attempting to do the job on this semi-continuous hot strip mill. We have not been successful to date. However, we have only tried it once.

M. D. Stone: I would like to ask what is the gage variation front to back of his coils? How does it compare with a continuous strip process?

Harold H. Warnock: I will repeat that we have no more gage variation from this so-called 4-stand continuous mill than we get from our 10-stand continuous mill at Cleveland or from our 10-stand continuous mill at Warren. We chill the front end of the bar in the roughing mill with 1200-psi water which does allow us to even up the gage front to back, with the exception of an occasional slab which any mill will get, which is cold on one end or has a cold spot. We have no more than 0.005 in. front to back. I know that that statement is correct, because the x-ray gages do not indicate any greater variation as the strip passes through.

Member: What is the approximate distance from your slab storage and preparation yard to your 48-in. mill furnaces, and how many railroad cars does it require to support the normal operation of your mill?

Harold H. Warnock: Our slab storage in Youngstown district is from three different sources. We have a steel yard adjacent to the 40-in. bloom and billet mill. We have a second slab yard which is nothing but a preparation yard and storage yard which is approximately a mile away from the mill, and occasionally we roll some bessemer slabs which are produced at the bessemer division of our district, which is approximately three and a half to four miles away.

We always have some 40 to 50 carloads of steel loaded ahead of us in railroad cars which presents some problems occasionally of equipment being used and demurrage. However, we try to load the schedule for the strip mill in our own equipment.

THE REVERSING HOT STRIP MILL

By A. F. KENYON
Industry Engineering Department
Westinghouse Electric Corp.
East Pittsburgh, Penna.

. . . . the reversing hot strip mill has some very attractive features for smaller plants with moderate tonnages . . . .

▲ WHEN the subject of a hot strip mill is mentioned, most engineers and steel plant operators immediately think of the highly developed and much publicized continuous type of mill consisting of many stands through which the strip passes successively, and with main driving motors totaling as much as 50,000 hp. The continuous type of mill has well demonstrated its ability to economically produce extremely large tonnages of high quality strip, and there is little question but that the large proportion of hot strip will continue to be produced in such large continuous type mills.

However, for the smaller plants having limited capital to invest, and requiring only a moderate tonnage output, the reversing type of hot strip finishing mill has some attractive features. The first installations were made nearly twenty years ago, and within the last 5 or 6 years, American manufacturers have supplied equipment for about ten mills, for installation in the United States, Mexico, South America, and Europe. The tabulation of Table I lists six of the recent mills for which our company have supplied the electrical drive equipment, and indicates the mill width, whether two-high or four-high, the ratings of the mill motor and of the furnace coiler motors, the mill speed, and the unit power of the main mill drive.

ARRANGEMENT AND OPERATION OF REVERSING TYPE HOT STRIP MILL

Before starting a description of the reversing hot strip mill, electrical drive equipment and its operation, a brief discussion of the mill arrangement, method of mill operation, etc., may be in order.

In a few installations, the strip mill consists of only a single reversing stand, and reheated slabs from 3 to 5 in. thick are reduced to strip by being passed back and forth through the mill. During the first few passes, the bar is run out flat on the tables, and when it has been reduced to about ½ in. thick it is directed up into the furnace coilers and thus coiled and kept hot between passes. As a matter of fact, the original installations, at the Dominion Foundries and Steel in Canada and at Altos Hornos in Mexico, operated for several years

TABLE I

Reversing Hot Strip Finishing Mills

No.	Company	Mill	Mill motor hp	Mill motor rpm	Roll fpm	Hp per in. per 100 fpm	Coiler motors hp
1	Newport Steel Corp., Newport, Ky.	54-in. four-high	4000	100/200	655/1310	11.3/5.65	150
2	McLouth Steel Corp., Trenton, Mich.	42-in. four-high	5000 D.A.	125/312	820/2050	14.5/5.8	300
3	A. M. Byers Co., Ambridge, Penna.	38-in. two-high	2500	75/150	570/1140	11.5/5.75	75
4	Com. Sid. Belgo Maniera, Brazil	40-in. two-high	2000	80/160	608/1215	8.2/4.1	50
5	Altos Hornos De Mexico, Monclova, Coahula	48-in. four-high	3000	70/175	440/1100	14.2/5.67	150
6	Lone Star Steel Co., Lone Star, Texas	72-in. four-high	7000 D.A.	125/250	885/1770	11.0/5.5	600

starting with 15-in. thick slab ingots and made the entire reduction from ingot to strip in the single two-high universal mill stand. However, with the roughing down and finishing all done in the one stand, the tonnage output was quite low, good surface finish of the strip was difficult to obtain even with frequent roll changes, and the two-high mill construction required for the ingot breakdown rolling was unsuited for the accurate finish rolling of wide thin strip.

Present practice therefore for installations rolling ingots directly to strip and also for some mills starting from reheated slabs, is to provide two separate reversing mills. The first mill is essentially a conventional universal slabbing or blooming mill, and in it the ingots (or reheated slabs) are rolled down to plate or bar, usually from $\frac{5}{8}$ to $1\frac{1}{4}$ in. thick. After cropping the front and rear ends, the bar may go directly to the second mill or it may be held briefly in a roller hearth furnace before proceeding to the finishing mill. The reversing finishing mill is of heavy construction and usually of four-high roll arrangement. In five or so passes the bar from the slabbing mill is reduced to finished hot strip from 0.060 to 0.150 in. thick. The bar may be run out flat on the table after one or more of the finishing passes, if starting from exceptionally heavy bar or if it is desired to check the straightness. However the furnace coilers are of heavy construction so that even after the first pass, if the bar has been reduced to $\frac{1}{2}$ in. or less, and after each succeeding pass except the last, the strip is directed up into one or the other of the two furnace coilers. The coiler mandrels are made of heat resistant alloy and carried on water cooled shaft and bearings, and are enclosed (except at the bottom) in a gas or oil fired insulating brick furnace structure so that the coiled strip is kept hot between passes. On the last pass the finished strip is run out over a runout table and coiled in a conventional hot strip coiler, or in some few instances may be cut to length by a flying shear and the cut sheets piled at the end of the runout table.

Figure 1 showing the schematic elevation arrangement of the mill rolls, furnace coilers, pinch and guide rolls, and tables, of a 72-in. mill now under construction, will illustrate some of the features of the mill operation. Assume that a bar comes to the finishing mill from a slabbing mill or slab furnace at the right and the first pass through the finishing mill is made from right to left. The deflector apron under the right furnace coiler will be down to let the bar pass under the coiler, and the right side guide roll and pinch roll will be raised. If the bar is to be run out flat after this pass the left side pinch roll and guide roll also will be raised and the deflector apron under the left furnace coiler will be down. However if the delivered bar is thin enough that it can

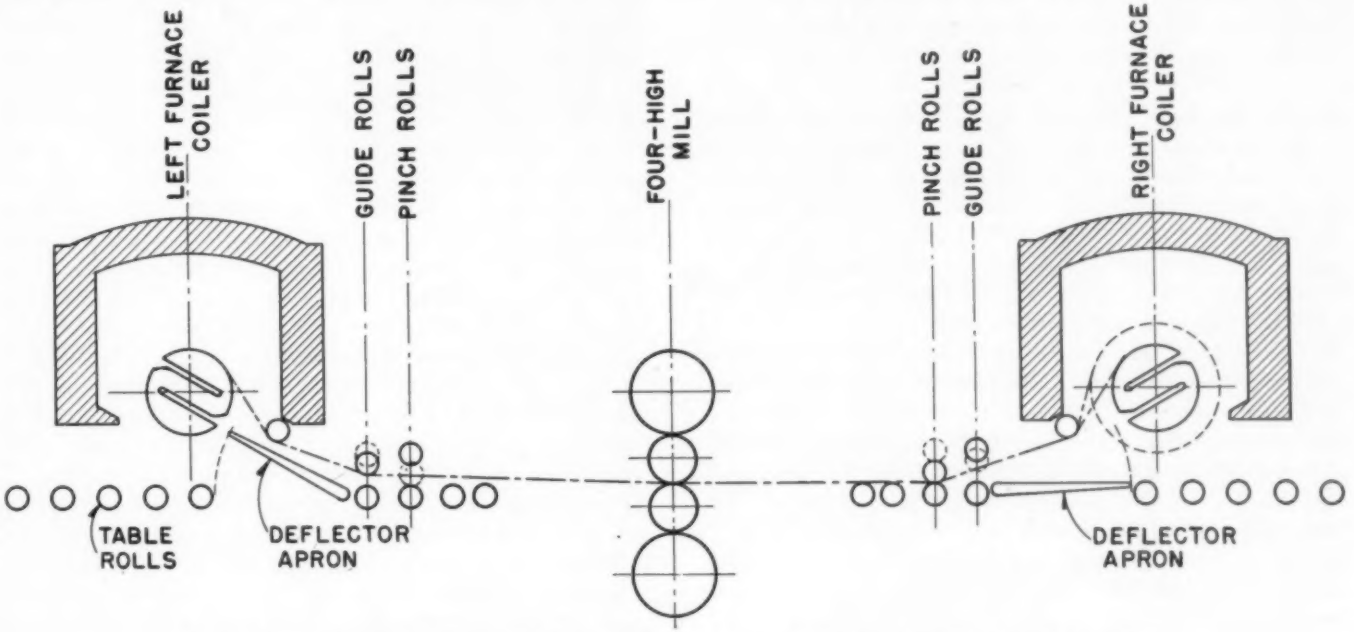


Figure 1 — Schematic elevation shows arrangement of reversing hot strip finishing mill.

be coiled, the left deflector apron will be raised, as shown, to direct the end of the bar up into the left furnace coiler. The coiler is started just as the bar enters the slot, and accelerates rapidly to bring the bar under tension by the time the coiler mandrel has made about one revolution. As soon as the coiler starts, the deflector apron is lowered so it will not interfere with the growing coil, also the left guide roll is lowered to establish the pass line just free of the table rolls. The left pinch roll remains raised out of contact with the bar since in this particular mill both upper and lower pinch rolls are driven. Also the mill may be accelerated to the desired running speed as soon as the bar is started in the coiler. At the end of the pass the mill (including the coilers, pinch rolls, tables, etc.) is stopped so that the tail end of the bar is between the mill and the left pinch rolls. The screws are set for the next pass, the right deflector apron is raised, the right pinch roll and right guide roll remain in their raised positions, the left pinch roll is lowered to pinch the bar, and the mill (including the left coiler, left and right pinch rolls, and tables) is started in the reverse (left to right) direction. The left pinch rolls serve to pull the bar from the left coiler and feed it to the mill, and just as soon as the bar enters the mill the left pinch roll is raised and the pass line to the mill is established by the lower position of the left guide roll. As the bar enters the right coiler, the coiler is

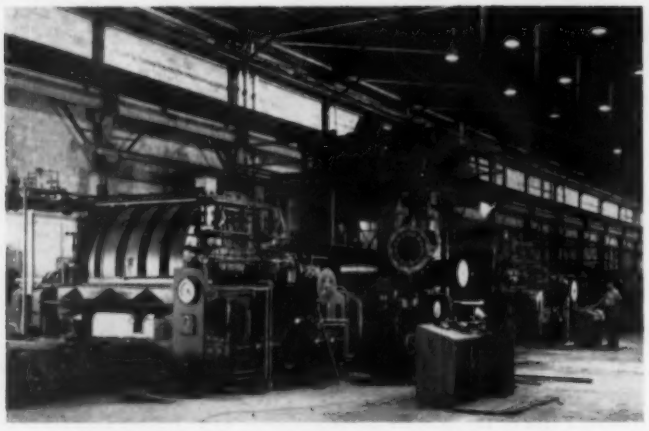


Figure 2 — This 54-in. wide four-high reversing hot strip finishing mill is located in a Kentucky plant.

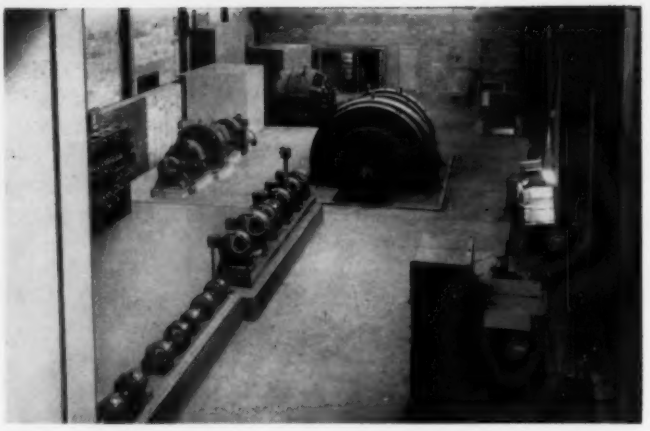


Figure 3 —Motor Room for the 54-in. reversing hot strip mill shown in Figure 2.

started, the right deflector apron is lowered, the right guide roll is lowered to establish the pass line, and the mill is accelerated to running speed. This reversing operation is continued for as many passes as are necessary to reduce to the required finished strip thickness, and on the last pass the strip is not directed up into the furnace coiler but runs out on the runout table to the finished strip coiler or flying shear.

It may be pointed out that the arrangement shown in Figure 1 applies only to this particular mill, and the exact arrangement of furnace coilers and guide and pinch rolls differs from one mill to another. Several mills have been installed which do not have a pinch roll stand between the mill and each furnace coiler, but have a so-called "handling roll" directly under each furnace coiler which may be raised up against the coiler mandrel to pinch and hold the strip until a few turns have been wrapped.

TYPICAL MILL INSTALLATIONS

54-in. wide four-high mill—Figure 2 is a view of a 54-in. wide four-high reversing hot strip mill installed in a Kentucky plant. The view shows the two furnace coilers, located above the entry and delivery tables about twenty feet from the mill. The two operator's master control benchboards are located on the mill floor opposite the furnace coilers. This mill is capable of rolling strip up to about 50 in. wide, and can operate at speeds up to 1300 fpm maximum. The threading speed at which the strip is started in the coilers is about 425 fpm. The finishing mill normally starts with bar about $\frac{5}{8}$ in. thick, rolled from slab ingots in a preceding reversing blooming mill and separate edger, and there is a roller hearth holding furnace operating at about 1850-1900 F between the blooming mill and the finishing mill to assure hot bar coming to the finishing mill even if there is a slight delay in finishing the preceding bar. Most strip is finished to about 0.105 in. average thickness in five passes, and usual production is about 90 coils of 9500 to 13,000-lb finished weight per eight-hour turn.

Figure 3 shows the motor room for the 54-in. mill shown in Figure 2. In the background is the 4000-hp, 700-volt, 100/200-rpm, main drive motor which is

Figure 4 — General view of a 38-in. wide, two-high reversing hot strip mill shows relative location of mill, furnace coilers, master control benchboards, and roller hearth holding furnace.

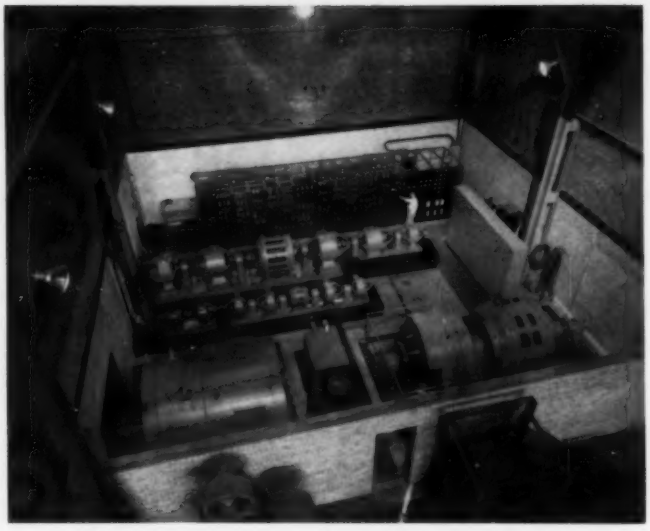


Figure 5 — Motor room for the 38-in. reversing hot strip mill shown in Figure 4.

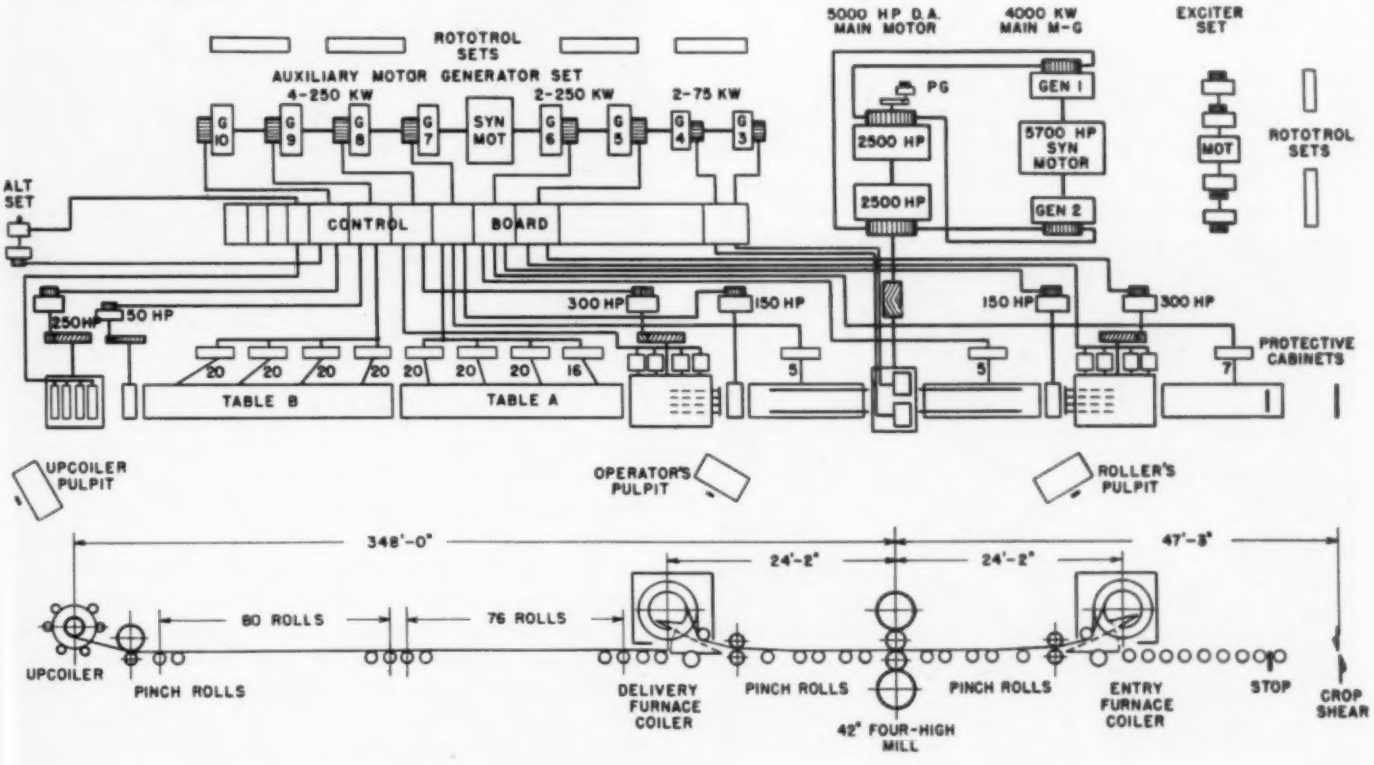
coupled directly to the pinions and 25-in. diameter mill work rolls. Power for the main motor is supplied by the 3500-kw synchronous motor-generator set. At the left is a portion of the control board and the auxiliary variable voltage motor-generator set serving the furnace coilers, handling rolls, mill and runout tables, and finished hot strip upcoiler, and in the foreground are the exciter and rotating regulator sets.

38-in. wide two-high mill—Figure 4 is a general view of a 29 x 38-in. two-high reversing hot strip mill located in the Pittsburgh district, and illustrates very well the relative locations of the mill stand, two furnace coilers, and two operators master control benchboards. At the right is shown the long roller hearth slab holding furnace. Figure 5 shows the compact arrangement of the 2500-hp, 75/150-rpm main motor, 2000-kw main synchronous motor-generator set, exciter set, variable voltage auxiliary motor-generator set, and the main drive and auxiliary control board. The rotating regulator sets for the main and auxiliary drives are installed in the rear frame structure behind the control board.

High speed 42-in. wide mill—The schematic arrangement of the 42-in. wide reversing hot strip finishing mill at the McLouth Steel Corp., Trenton, Mich., is shown in Figure 6. At the bottom of the figure is a schematic pass line elevation arrangement for the mill, showing the relative location of the 25-in. and 49-in. x 42-in. four-high mill stand, furnace coilers, pinch rolls, tables, and finished strip upcoiler. The upper part of the figure shows the schematic arrangement of the main roll and auxiliary electrical drive equipment.

The main working rolls of the four-high mill are driven by a 5000-hp, 125/312.5-rpm double armature motor which is supplied from a three-unit motor-generator set consisting of two 2000-kw, 700-volt d-c generators and a 5700-hp synchronous motor. The double armature construction of the 5000-hp main motor was necessary because of the relatively high speed and the wide speed range. The nine-unit auxiliary motor-generator set consists of a 1250-hp synchronous driving motor, two 75-kw generators for the screwdown, and six 250-kw generators for the other auxiliary drives. One 250-kw generator No. 5 supplies the 300-hp entry furnace coiler motor and four 3-hp table roll and deflector roll motors, and generator No. 6 supplies the 150-hp entry pinch rolls motor and twelve approach table and entry table roll motors. Generator No. 7 supplies the 150-hp delivery pinch rolls motor and five delivery table motors, and during the last pass this generator

Figure 6 — Schematic pass line arrangement and schematic electrical connections for 42-in. wide, four-high reversing hot strip finishing mill.



also supplies the 76 motors driving the first section of the runout table. Generator No. 8 supplies the delivery furnace coiler and four roll motors. Generator No. 9 supplies the 80 3-hp motors driving the second section of the runout table and the 50-hp upcoiler pinch rolls motor, and the last of the 250-kw generators No. 10 supplies the 250-hp upcoiler mandrel motor and the blocking roll motor alternator set.

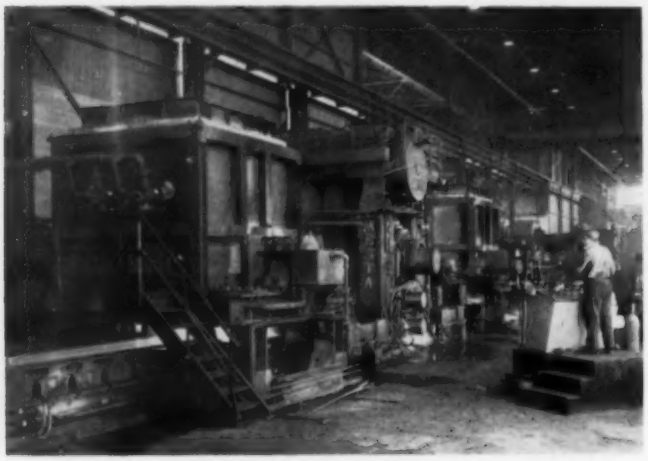


Figure 7 — General view of 42-in. wide, four-high reversing hot strip finishing mill. Mill is designed for 2050-fpm maximum delivery speed.

Figure 7 shows this 42-in. wide mill in operation, with a finished strip running out on the runout table under the delivery furnace coiler. The two master control benchboards, one opposite each furnace coiler, are raised about two feet above the mill floor to afford a better view of the strip. Note also that the benchboards are not set parallel to the mill line but are turned about 45 degrees so that the operators face toward the mill stand. Figure 8 is a closeup view of the entry side or "roller's" master control benchboard. At the lower left are the large dial type screwdown position indicator and the screwdown master switch.

The runout table and cooling sprays are shown in Figure 9. The table rolls are 12-in. diameter, spaced 24-in. apart, and are individually driven by 3-hp, 750-rpm d-c motors. Figure 10 shows a finishel coil as it is

Figure 8 — Roller's master control benchboard.

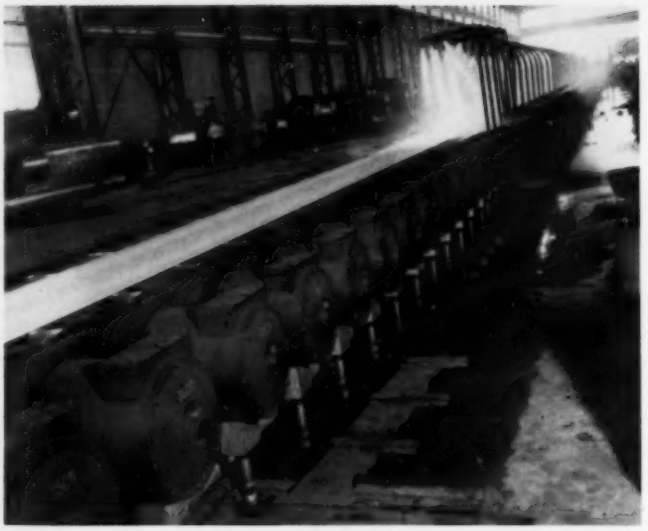


Figure 9 — Runout table is similar to a continuous mill with rolls individually driven by 3-hp, d-c motors with variable voltage control.

being pushed from the mandrel type upcoiler onto the coil conveyor. The upcoiler is located at the end of the runout table, about 350 feet from the mill.

Figure 11 is a general view of the 42-in. mill motor room. In the upper background are the 4000-kw main motor-generator set and the 5000-hp double armature main reversing motor. In the foreground are the nine-unit auxiliary motor-generator set, and the twenty-five panel control board which provides the entire control of the main drive and all of the auxiliaries. The electrical equipment is ventilated by a downdraft air cooling and recirculating ventilation system. A closeup view of the 5000-hp, 125/312.5-rpm double armature main reversing motor is shown in Figure 12.

Figure 10 — Mandrel type upcoiler at end of runout table is used to coil the finished strip on the last pass.

This 42-in. wide mill is designed for operation up to maximum speed of 2050 fpm, which at the time the mill was installed was more than 50 per cent faster than any other reversing type hot strip mill, and some doubt was expressed as to whether such high speed could be used. However for the usual light gauge strip produced on this mill, this high speed has proven to be well justified. The bar coming to the mill varies from 0.550 to 0.800-in. thick depending upon the width and thickness of the strip to be finished. The mill is operated at a uniform

threading speed of about 550 fpm while starting the strip through the mill and onto the winding side furnace coiler, and even at this high threading speed, only a moderate loop is thrown up between the mill and furnace coiler before the coiler comes up to speed and brings the strip under tension after about one revolution of the coiler mandrel. The running speed for a usual schedule is about 820 fpm (base speed) for passes 1 and 2, 1250 fpm for pass 3, and 1750 fpm for pass 4. On the last pass the mill is operated at about 1500 fpm until the head end of the strip has entered the upcoiler at the end of the runout table, and the speed is then increased to 2050 fpm and the rest of the pass is made at maximum mill speed. The average finished strip thickness is about 0.085 in., and in widths up to 30-in., 0.0625-in. thick strip is produced. Ingots rolled in the preceding slabbing mill range up to 24,000 lb, and a complete ingot is finished to strip in one coil enabling the production of coils of 20,000-lb or more finished weight. Maximum rolling rates approach 750 net tons per 8-hour turn, and the monthly output has exceeded 50,000 tons.

New 72-in. wide mill—Brief mention may be made of the 72-in. wide mill now being installed in Texas by the Lone Star Steel Co. and which will be ready for operation early in 1953. The mill is intended primarily to produce skelp for two large electric weld pipe mills

Figure 11 — General view of 42-in., reversing hot strip mill motor room shows 4000-kw motor-generator set and 5000-hp main motor in background and nine-unit auxiliary motor-generator set and control board in foreground.

to serve the oil industry, hence the finished strip or plate will be thicker than would be expected from a strip mill. The mill layout includes a mandrel type upcoiler to enable finishing strip up to 66 in. wide and up to 0.3125-in. thick in coil form, also a flying shear to cut strip up to 0.5625-in. thick into 33-66-ft lengths and deliver the cut lengths to a piler. The 72-in. mill width is a third wider than other reversing type mills, also the mill is designed for 885/1770 fpm delivery speed range which is exceeded only by the 42-in. mill previously described. The main drive motor will be 7000-hp, 125/250-rpm, of double armature construction, and supplied from a 6000-kw synchronous motor-generator set. Each of the two furnace coilers will be driven by a 6000-hp motor, providing tension capacity of about 10,500 lb at any speed up to the 1770 fpm rated maximum mill

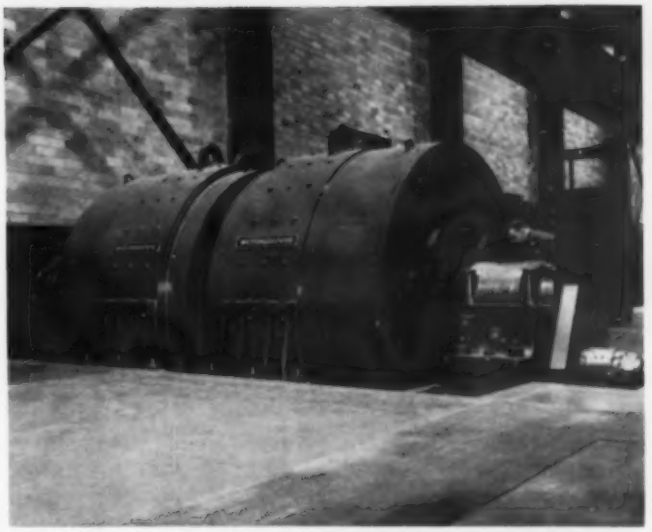


Figure 12 — This 5000-hp, 125/312.5-rpm double armature main drive motor is used for 42-in. reversing hot strip finishing mill.

speed. Two seven-unit auxiliary motor-generator sets, each driven by a 1750-hp synchronous motor and with twelve generators totaling 3130 kw are required for the variable voltage operation of the slab crop shear, roller hearth slab holding furnace, two furnace coilers, pinch rolls, tables, flying shear, and finished strip upcoiler.

ELECTRICAL EQUIPMENT AND OPERATION

Now that several reversing hot strip finishing mill installations, and general mill operation, have been described, it is desirable to take a closer look at some of the electrical features.

Main mill drive—For a medium size moderate speed mill, the main drive motor will be of rating and construction typical of other reversing mill drives. However the working rolls of four-high mills are usually only 24 to 27-in. diameter and to achieve delivery speeds of 1500 to 2000 fpm requires quite high motor speed, as well as large horsepower capacity. This frequently necessitates double armature construction of the motor.

The passes are of quite long duration so that a flywheel on the power supply motor-generator set is of little use in equalizing peak loads, hence synchronous motor-generator sets have been used for practically all mills.

The control and regulating systems for the main drive are similar to other reversing mill drives, including an exciter and rotating voltage regulator for the supply generators, and an exciter, rotating field current regulator, and rotating regulator current limit bias for the reversing motor. In general the equivalent WR^2 and stored energy in the four-high mill and its drive motor are higher than on other reversing mills so that the phenomenally high acceleration rates recently publicized for some large blooming mills are not possible. Also it must be kept in mind that the furnace coilers, tables, pinch rolls, etc., must accelerate and decelerate with the mill, hence it is desirable that the mill drive acceleration be uniform rather than varying with mill load, and some installations have used a motor oper-

ated rheostat to control the generator and motor rotating regulators and obtain the required uniform acceleration and deceleration of the mill.

Tables and pinch rolls—The table roll motors and pinch roll motors are operated with fixed field excitation, and all speed control is by generator voltage adjustment. The generators are controlled by rotating voltage regulators with IR compensation and current limit protection, and matched against the mill pilot generator so that the voltage and hence motor speeds are essentially proportional to the mill speed. The pinch rolls are used only to pull the strip from the adjacent furnace coiler and start it into the mill on the return pass, and in emergency to help remove cobbled strip from the coiler or mill. During normal rolling operation the pinch rolls are separated and out of contact with the strip so that it is not necessary that their speed exactly match the mill speed.

Furnace coilers—The furnace coilers, which coil and keep the strip hot between passes, are a most important part of a reversing hot strip mill, and their proper performance under all the varied conditions of threading, starting, running, resetting, etc., contributes greatly to the successful operation of the entire installation.

As shown by the schematic diagram in Figure 6, each furnace coiler motor (together with a certain few of the table and deflector roll motors) is supplied from a separate adjustable voltage generator. Each coiler generator is voltage regulated with IR drop compensation against the mill pilot generator so that the coiler voltage is proportional to the mill speed. The coiler motor is controlled by a rotating constant current regulator to compensate for coil diameter, and the combination of the generator voltage regulator and motor current regulator constitutes a fairly conventional constant tension regulating system to alternately maintain back tension on the strip being unwound and fed into the mill or forward tension on the strip being delivered from the mill.

The earlier mills had so-called "paddle" type coilers, into which the strip could be entered with the coiler running slightly faster than the mill threading speed, thus requiring a relatively simple control system and enabling bringing the strip under tension very quickly and with only insignificant looping. However, the operation of such coilers was not entirely successful, as the paddle construction of the mandrels was not too rugged and the mandrels became distorted or broken from the furnace heat and the occasional bad cobbles thus required considerable maintenance. Also the end of the strip frequently struck one of the cross "paddles" (especially if it was distorted and out of line) rather than going into the space between adjacent paddles, thus cobbling the strip and delaying production.

Therefore most mills now have "single slot" coilers, and with this type of furnace coiler the strip must enter the slot in the coiler mandrel with the coiler at rest. This immediately imposes two rather exacting requirements on the coiler drives. First, at the end of each pass the coiler from which the strip has just been unwound must be automatically "reset" with the slot in position to receive the strip on the return pass. This is fairly readily accomplished by means of a reset limit switch driven from the coiler, however the resetting must be completed within a very few seconds in order not to delay starting the next pass so that the resetting speed must be moderately high. Also the stopping at the reset position must be accurate within plus or minus one degree regardless of whether the reset movement is small or almost a complete revolution, so that controlled slowdown is required as the reset position is approached.

Second, the coiler acceleration from standstill to the mill threading speed must be extremely fast in order to avoid throwing an unmanageable loop between the mill and coiler, but this fast acceleration must be perfectly controlled in order to take up the accumulated loop and to bring the strip under tension without excessive jerk by the end of about one revolution of the coiler mandrel. This resolves itself into a problem of elementary calculus, which may be simply explained by Figures 13 and 14.

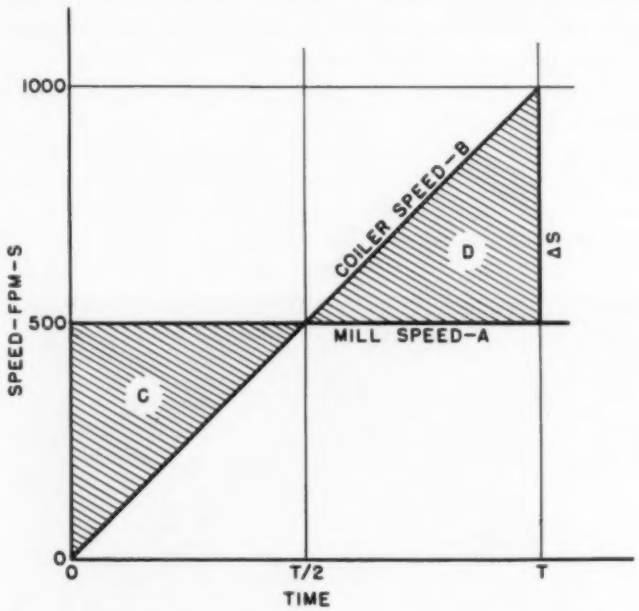


Figure 13 — Furnace coiler starting characteristics are shown for uniform acceleration.

In Figure 13 the horizontal line A represents the threading speed of 500 fpm or 8.33 fps at which strip is being delivered from the mill, hence the total area under this line is the length of strip delivered from the mill or 8.33 fps multiplied by the time in seconds. If we assume that the coiler starts from rest and accelerates at a constant rate, so that its speed is as shown by line B, the area under line B is the length of strip wound up by the coiler, and the difference between the areas under lines A and B is the loop length, and we see that the coiler must accelerate to twice the mill speed in order to take up the loop and bring the strip under tension. This wide difference between strip speed and coiler speed when the loop disappears is very objectionable as it may pull the end of the strip out of the coiler slot, may break the strip, or at least will impose extreme shock stresses on the coiler and its drive. Also, good performance requires that the strip be brought under tension just about at the end of the first revolution as earlier tightening up may pull the end of the strip out of the slot, and tightening up after more than 1¼ revolutions leaves the inner turn loose on the mandrel with result-

ant poor coiling. Thus this relatively slow uniform acceleration results in a large maximum loop as represented by area C.

Thus it can be seen that the uniform acceleration characteristic is impractical, and the acceleration characteristic must be adjusted so that the coiler accelerates more rapidly during the first part of the starting cycle. This faster acceleration results in a smaller maximum loop so that the coiler overspeed can be reduced and the coiler can be decelerated to just slightly above the mill threading speed. Thus the strip is brought under tension with little shock on the equipment and minimum danger of breaking the strip or pulling the end of the strip out of the slot. This ideal acceleration characteristic is shown by Figure 14, and a close approximation of this ideal can be obtained by a slight underdamping of the generator voltage regulator together with the momentary application of a step function to increase the forcing and obtain a rapid initial rate of generator voltage rise.

We have already mentioned that the winding furnace coiler must be started just as the head end of the strip enters the coiler slot, also that at the end of the pass, the entire mill must be brought to a stop with the tail end of the strip through the mill but not through the winding side pinch rolls. On some mills, photo-electric relays or air jet switches actuated by the passage of the end of the strip, together with adjustable timers, have been used to initiate the starting of the winding coiler

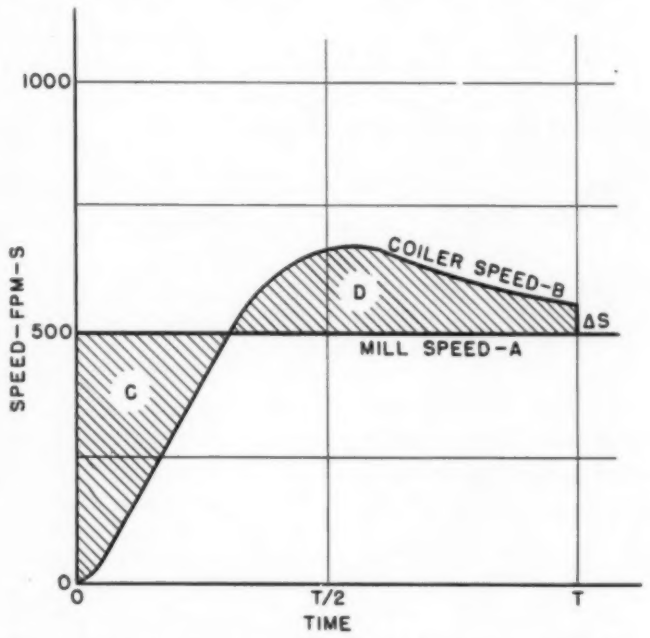


Figure 14 — Furnace coiler with ideal starting characteristics has stepped acceleration.

and to initiate the slowdown and stopping of the mill. Under normal conditions, such automatic controls have functioned satisfactorily and are regularly used. However unusual smoke or steam conditions, or neglected cleaning of the lens system, may cause erratic operation of photo-electric equipment, and mill cobbles—which will occur even on the best performing mills—may cause damage or destruction of either photo-electric or air-jet operated flag switches. Some operators therefore will not use such automatic controls, and depend entirely upon the skill and alert response of the two benchboard operators to manually initiate the starting of the winding coiler (which also initiates the speed-up from threading to the selected running speed) and to manually initiate the slow-down and stopping of the mill at the end of the pass.

On moderate speed mills, the slowdown and stopping of the mill at the end of the pass need not be initiated until after the tail end of the strip has left the unwinding coiler. However on high speed mills, even with a high deceleration rate, the length of strip rolled during the deceleration cycle may be greater than the distance from the unwinding coiler to the point between the mill and winding side pinch rolls at which the strip must stop, so that the slowdown must be initiated before the tail end of the strip leaves the unwinding coiler. This requires an accurate indication of the number of turns remaining on the unwinding coiler, and we have developed a special wrap counter meter for this purpose. The counter must start from zero as the strip enters the winding coiler so that it will "uncount" (to coin a word) back to zero during the next pass, hence the wrap counter must automatically reset to zero at the end of the pass even though the coiler rotates after the strip leaves. Also an indication is required down to tenths of a turn even though the coil may have several hundred turns, so that the counter has a main pointer and a vernier pointer. It also has contacts to actuate a signal when the coil has unwound back to the last ten turns and thus warn the operator to be ready to initiate the final slowdown and stopping at the proper point.

Another requirement of the furnace coiler control is to rotate slowly the coiler mandrel, (and the immediately adjacent table and deflector rolls) during such time that the mill is not rolling and during the passes when the strip is not being coiled or uncoiled, to avoid uneven heating and resultant distortion.

Operators benchboards and master control—It was mentioned previously that the master control of the mill operation is from two master control benchboards, located about 40 feet apart and approximately opposite the furnace coilers, so that the benchboard attendants have a clear view of the mill and of the sideguards, pinch and guide rolls, and furnace coiler, on their respective sides of the mill. One benchboard is designated as the "Roller's" benchboard, and on it are provided ammeters for the mill and each furnace coiler, mill speed meter, screwdown master switches, coiler tension adjusting rheostats, running speed selector switch, and selector switch to select for coiling or flat pass operation on either side. The second benchboard is termed the "Operator's" benchboard, and on it are provided a mill speed meter, and the main master switches. Also on both benchboards there are provided pushbuttons for coiler start and mill speedup, and mill stop, auxiliary jogging control switches for the mill, pinch rolls, and furnace coiler, and auxiliary control switches for emergency manual control of the sideguards, pinch and guide rolls, and coiler entry deflector apron. Thus the roller makes the screwdown settings, selects whether to coil or roll flat on each pass, selects the running speed for each pass, selects the coiler tensions, and observes the loading on the mill and coiler motors, and thus determines the schedule by which each coil is to be rolled

and processed. The operator controls the mill, sideguards, and pinch and guide rolls, to mechanically operate the mill. The roller and operator each has responsibility to initiate the coiler starting and mill speedup as the strip enters his respective coiler, and to stop the mill at the end of the pass when the strip leaves his respective coiler. Each man has jogging and emergency control of the machines on his side of the mill to start a new slab, clear cobbles from the mill, etc.

The "coil-flat pass" selector switch sets up circuits for the proper functioning of the pinch and guide rolls, furnace coiler, coiler entry deflector apron, etc., to coil or roll flat on either side of the mill. Thus when the delivery side is selected for "flat pass" the delivery pinch and guide rolls move to their fully open or raised positions, the delivery coiler entry deflector apron is down so the strip runs out on the table under the coiler, the runout table is picked up so that it runs and is speed matched to the mill, the delivery furnace coiler runs continuously at slow speed to avoid uneven heating, and the coiler start and mill speedup pushbutton is made to only initiate the mill speedup but not to start the coiler. When the delivery side is selected for "coil," permissive circuits are set up to the pinch and guide rolls so they can move to the "guide" and "pinch" positions as required, the coiler entry deflector apron is up to direct the strip up into the coiler, the runout table is dropped off, the delivery furnace coiler resets with its slot ready to enter the strip, the wrap counter resets to zero, and the coiler start and mill speedup pushbutton is made effective to start the delivery coiler as well as to initiate the mill speedup.

The roller and operator naturally are kept quite busy during the slowing down and stopping at the end of one pass and the starting at the beginning of the next pass, so that insofar as practicable the controls of the various movements are interlocked or controlled from the same master switch to function automatically in sequence, with minimum separate control by the roller or operator.

SUMMARY

The modern reversing hot strip finishing mill has proven itself capable of producing satisfactory quality strip, and its moderate capital cost and economical operation recommend it for plants requiring only small or moderate tonnage output.

The electrical drive equipment must meet varied operating requirements not encountered on other types of mills, and this paper has endeavored to describe the equipment and operation of this very interesting mill, and to discuss some of the special problems and their solution.

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DYNAMIC PAINTING IN STEEL PLANTS

By JOSEPH K. SEYLER
Superintendent
Hazelwood Cold Finishing Department
Jones & Laughlin Steel Corp.
Pittsburgh, Penna.

. . . . colors have an important effect on the worker's attitude, safety and efficiency in plant operations . . . .

▲THE opinion is rather widely held by the general public that the business of making, shaping, and treating of iron and steel products is a dirty, hazardous, and not too desirable business. Public acceptance of our business is predicated almost completely on the fact that without steel, life as we know it today would be almost too hopeless and difficult to contemplate. Any attempt of steel or similar companies to expel these falsely held conceptions is a difficult task, because the visible evidences of our operations are in themselves misleading. Most steelmen have witnessed the magnificent fury of flame and sparks emitted from a bessemer converter lighting up the black of a night sky. It is from such visual evidences as this, that the public's conception of our operations are gained.

It may come as a distinct surprise to know that within our industry, there are many plants which are as safe, clean, orderly, and colorful as any to be found in the food preparation, baking or pharmaceutical industries, and it must be admitted that these latter industries lend themselves to such housekeeping far more readily than does the steel industry.

You may ask the question, "How have these startling changes been accomplished?" First, they are the direct result of progressive managements who refused to believe that a steel plant must necessarily be dirty and hazardous. Secondly, and of equal importance was the decision to adopt and liberally apply the principles of color dynamics.

What precisely is color dynamics? Color dynamics is nothing more or less than the scientific utilization of the energy in color to promote efficiency and safety in industry. To more thoroughly understand what is meant by the energy in color, one must go back briefly in history and discover just what is known about color and light.

Many people associate Isaac Newton with the discovery of the law of gravity. Some remember Newton as an experimenter and discoverer of certain theories of light. Few people recognize the fact that Newton is the father of another important science, that is harnessing, in the principles of color dynamics, the potent force of color to promote efficiency in industry.

Newton's experiments following discovery of the true nature of light and color were exhaustive. He made some minor errors which have been corrected, but in the main he has given the world its basic knowledge of color. From him, for example, we know that the color of any object is obtained by selective reflection, i.e., when light strikes an object, only certain colors are reflected and others are absorbed. Although Newton's color discoveries gave rise to widespread mathematical and philosophical discussions in the following years, little or no practical application of his findings were made until nearly 130 years after his experiments. This was largely because Newton, his contemporaries and immediate followers, did not clearly recognize or understand the basic inter-relation of color and wave lengths, i.e., that color is a specific that could be measured and used. At the turn of the nineteenth century Sir Thomas Young, of the Rosetta Stone fame, discovered that the colors of Newton's spectrum moved in definite wave

lengths. By proving that the waves of red light, for example, were longer than those of violet, he opened the doors for later discovery of the ultraviolet rays by Edmond Becquerel in 1842; infrared rays by Sir William Herschel in 1800; and X-rays by Professor Roentgen in 1890.

It seems strange that the first practical employment of the knowledge of light and color was devoted to those rays and wave lengths invisible to the naked eye. The use of X-rays, ultraviolet, and infrared preceded the adaptation of knowledge of color to practical formulas to assist mankind. In 1936, approximately 280 years after Newton's first discovery of the visible spectrum, research men first used color as a specific on a practical basis. The fundamental characteristics of color were reduced to a given formula expressed as the principles of color dynamics. Through this formula certain prescribed effects could be obtained with color. Much of the knowledge utilized in these first attempts at using visible color as an actual tool was derived from isolated studies of color and light covering nearly three centuries. This data had to be culled from pure science. This presented many complex problems which the color engineers had to solve before color could be compacted into usable and practical form.

Progress was slow but certain with research covering broad fields. Scientists, ranging from botanists to oceanographers, were discovering new and important facts about color and its effect on nature, people, and the life processes. A micro-biologist found that barnacles did not like light surfaces and that ship bottoms painted white, yellow, or light green would repel the creatures. Working with weights, other scientists proved that the average person will judge weights heavier under red light than under green or blue light. They also found that people will imagine that boxes painted a light color will seem less heavy than the same boxes painted black. Scientists studied the effects of color on blood pressure, and upon muscular, mental, and nervous activity and measured it dynamometrically. Another investigator found that by subjecting a person to a given range of colors for five minutes each, there could be detected differences in the effect of the various colors upon physical activities, memory, and mental work. These seemingly isolated, yet inter-related findings constituted a phase of the research activities of color engineers concerned with developing the use of color on a sound, scientific basis.

Light or color is electromagnetic energy and the visible light or color is one octave of the electromagnetic spectrum which contains from sixty to seventy octaves. The power of X-rays, ultraviolet, and infrared rays are well known and have been used by medical and therapeutical science to perform certain functions. These rays are neighboring octaves of the visible light rays, and if the invisible rays have motion or energy, it must be concluded that the visible rays possess the same power.

In the field of human behavior, it has been definitely established that color not only has a physiological effect on the human eye and nervous system, but it also has a profound psychological reaction on the mind. Certain colors have the "power" to elevate the mind while others can blunt the nervous system and act as depressants. Still others create confusion. The mental and physical impact on a person of proper and improper color can be compared with the reaction caused by sound or more particularly by music. The discord of untrained musicians has a jarring effect usually to the point of physical reaction. On the other hand, the beautiful cadences of a trained symphonic group can guide the mind and body through various moods ranging from sadness to sublime happiness. Color harmony produces essentially the same reaction as any other harmony—when properly utilized a particularly desired effect is produced—when improperly used it creates a discordant element.

In the study of color, considerable progress has been made concerning the proper correlation of light and color in factories and industrial plants. This understanding has come late. In one of the most outstanding demonstrations providing the close relationship of color and light, a piece of black thread is placed on a black cloth and an attempt is made to distinguish the thread. Under normal conditions 2,100 foot-candles are required to see the thread, but a piece of white thread on the black cloth requires only one foot-candle for equal visibility. The black-on-black test before the introduction of color dynamics, had innumerable parallels in industry. It had been the practice to paint machines gray, and in most cases a shade closely approximating the gray of the metal being worked upon. Operators could not clearly distinguish where the machine left off and the metal began without terriffic strain on their eye muscles and nerves. Under such conditions an operator raised his eyes for relief, and he invariably encountered walls painted a glaring white in maximum contrast to the dark gray, with the result that the eyes were overworked and strained by the numerous adjustments required.

After intensive experimentation on machinery and plants with tests incorporating discoveries in the color and color-light fields, color engineers have formulated their findings in the principles of color dynamics. With their research spurred by necessity, they have finally harnessed the inherent power and productivity of color for practical industrial use. From the first, color helped increase the quantity and quality of production, reduced accidents, cut absenteeism, and raised morale through scientific use of its natural psychologic, symbolic, and visual powers. Color does its work in the industrial plant by "moving" critical parts of machinery into focus, "moving" ceilings upward and walls outward, and bringing assembly lines and materials into sharper contrast without actual motion.

In essence, the scientific use of color is based upon principles somewhat similar to camouflage, but in application is diametrically opposite. To camouflage an object, color is used to mislead, to hide, or to obscure; in color dynamics, color is used to highlight, to reveal, to emphasize, and to utilize. Basically color dynamics seeks to adapt to, and improve for man-made surroundings, the color harmony found in nature's pleasant color combinations. The first job of color in its application to machinery is to separate the critical parts from the material worked upon. The efficiency obtained with use of contrasting colors was previously illustrated by the white thread on a black cloth test.

Carrying this principle to machinery, color dynamics gives the critical or operating parts a color that comes quickly to the eye—a color that "moves" in strong contrast to the stationary or non-critical parts on the machine. The primary purpose of focal color is, in combination with contrasting colors, to focus the worker's attention exactly where it should be, on the object being produced, with the least possible effect on the eye muscles. As the critical machine part must move forward the non-critical parts must drop back. After careful study and research a receding color known as "Vista Green" has been developed for the body of the machine. No other color has such a relaxing and soothing effect on the human eye as has green and yet it does not in any manner suggest depression.

There is nothing that can cheer up an employee so much as a bright, pleasant place in which to work. All other things being equal, almost everyone feels a bit more light-hearted on a sunny day than when the skies are overcast. By using colors that suggest sunshine and nature, the interior can be made infinitely more cheerful. In plants where temperatures must necessarily be high, color dynamics calls for cool colors to act as a mental and emotional stabilizer. Warm shades are advisable where low temperatures must be maintained.

The objectives of color dynamics are: (1) to promote continuity of employment, (2) to improve efficiency of operation, and (3) to maintain quality of production.

The morale and efficiency of industrial workers are drastically affected by certain physical conditions under which they work. Continued eyestrain leads to nervous tension—causes unnecessary fatigue. Drab, cheerless surroundings encourage mental depression—make the job seem harder. The color dynamics system eliminates these negative factors. It also reduces the even more insidious "absenteeism on the job" in which a worker is continually finding reasons to leave his machine.

Since color dynamics is concerned not only with the factory background of walls, floor and ceiling but also with the machines, eye-strain and the resulting fatigue are minimized, the workers themselves remain more alert and are better able to avoid hazards.

Management and labor can see eye to eye on the subject of color dynamics. From the viewpoint of the employee the purpose of color dynamics is to make his working day easier—to keep him happier on his job—and to contribute to his safety—to guard his health by eliminating insidious "eye fatigue," which frequently is the cause of nervous tension.

Every production manager wants his workers to stay on the job—to process the maximum quantity of material—and to have the quality of that work measure up to the highest standards. Color dynamics can make a real contribution toward the attaining of these three objectives. Color dynamics means more and better work per man-hour—and more man-hours per man.

DISCUSSION

PRESENTED BY

PAUL E. THOMAS, Assistant General Superintendent, United States Steel Corp., Gary, Ind.

JOSEPH K. SEYLER, Superintendent, Hazelwood Cold Finishing Dept., Jones and Laughlin Steel Corp., Pittsburgh, Penna.

S. EIN, Electrical Senior Engineer, Inland Steel Co., East Chicago, Ind.

Paul E. Thomas: We at Gary Steel Works have used the principle of color dynamics in our machine shop. We feel that the housekeeping and safety have improved due to the use of color dynamics. I personally think that it may have increased the shop efficiency; however, we have not made any studies on the subject. I would like to ask Mr. Seyler if he has made any tests or studies to evaluate the increase in productivity or efficiency due to color dynamics.

Joseph K. Seyler: I have no direct figures which would indicate an increase in productivity as far as my personal experience is concerned. My plant happens to be a cold drawing plant, and we went to color dynamics primarily because our housekeeping problem was one which was extremely difficult. Many of you know everything we do in cold drawing is done in conjunction with the use of oils, drawing lubricants or soaps. They are very messy things to handle, especially in the volumes that we have to use them.

The net result is that housekeeping is a terrific job, not only on floors, but on the equipment; and therefore we went to color dynamics because in utilizing the principles of color dynamics they immediately brought into sharp focus any dirt, oil or grime that happened to be around. Consequently it was not quite so easy to pass up any dirt that might be on the machines. The operators would have a tendency to wait until the accumulations of oil became so heavy that they literally had to be scraped off.

Now with these bright colors, dirt and grime is quite obvious, and operators will, on their own volition, proceed to clean them up. We do notice that the safety angle concerned with our plant is much better. We recently ran 4,800,000 manhours without any accidents. It represented the longest single safety run of any department in our corporation. We attributed a considerable amount of that safety program to color dynamics principles, but as far as productivity is concerned, we have not made an actual study of it.

S. Ein: The use of color dynamics in the major steel divisions (blast furnaces, open hearths, and rolling mills) is more difficult to achieve than in the shops and cold mills described in the article where there is a fertile field for its use. Despite difficulties in using it, there is enough to be gained in the major divisions to justify attempts to use color dynamics.

Color dynamics can also be used with very good effect in offices, both in those offices in the plant which are usually drab, and in the main offices. In all these locations, everything the author describes will be accomplished when the illumination is secured from an adequate number of large fluorescent fixtures, and when light colors are applied to the desks and other furniture, the floor covering, and the walls.

By LEON D. COOK
Supervisor Substations
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The Meaning of Commutator Film

. . . . the characteristics of commutator film can give the experienced operator much helpful data for the most efficient operation of his electrical equipment . . . .

▲ THE majority of readers of this paper will be well informed on the fundamentals relative to the correct electrical and mechanical adjustments necessary for good commutation on direct-current machines. Much information is available on this subject from the text book or instruction data from the machine manufacturers. It is the intention to deal here with the relatively little discussed, day to day, on-the-job diagnosis and correction of commutator and brush difficulties. To use an analogy the physician is enabled to diagnose bodily ills by the observance of the texture and quality of the patients skin, so the engineer may use this method to diagnose direct-current machine troubles by the observation of the quality and texture of the commutator skin or film.

An analysis of commutator film will show it to be composed of copper oxides and brush material, plus a trace of dust particles captured from the atmosphere. The total thickness of this important layer is only a few millionths of an inch, this accounts for the difficulty often experienced in maintaining the commutator films desired, particularly at the higher operating speeds. This film has lubricating ability, enabling brushes to operate at relatively low friction and wear. This lubricating property has been shown to be due to a layer of water molecules adhering to, or absorbed on, the surfaces of graphite or carbon crystals at the surface of the film. The source of the water is the moisture normally contained in all atmosphere. It will be shown later where the absence or reduction of this water will bring about very high brush frictions and exceedingly rapid wear.

The process of film formation is the result of a continual deposit of brush material by the negative brushes (on a generator) and the oxidation of copper at the contact surface. While the negative brushes are in the process of depositing material, the friction of the positive brushes are continuing to remove it. As the layer becomes thicker, its removal by the positive brushes becomes proportionately greater, until a point of equilibrium is reached and the film becomes stationary. After this, the quality and thickness of the film may pass through wide variations, caused by any number of outside forces. Sufficient film to provide for a normal operating friction and contact drop is completely formed in about 80 minutes at a peripheral speed of 5000 fpm. However, the point of equilibrium or stabilization described above may not be reached until after 10 days or more of operation.

RELATIVE MERITS OF FILM THICKNESS

The quality and the degree of thickness at which the commutator film becomes stabilized is of vital importance to brush performance. Therefore when brushes are selected for a machine, the quality of film best suited to the machine in question together with a knowledge of how this film may be obtained should be understood. In some cases the classical chocolate brown film so often referred to in the carbon manufacturers descriptive literature may produce the results desired, but unfortunately this is not always the case. Any discussion of the commutator film desired seems to be rather contradictory. To clarify this subject the beneficial effects or difficulties that may result from a commutator film stabilized too soon (thin or light colored film) or stabilized too late (thick or dark film) will be listed for comparison.

Beneficial effects that may be expected from a thick dark film are:

1. Low frictions.
2. High contact drop.
3. Long brush life.
4. Minimum commutator wear.

Deteriorating effects that may be expected when the film is too thick are:

1. High commutator temperatures.
2. Copper picking and streaking.
3. High friction and brush chatter.
4. Short brush life.

5. Sparking and bar burning at the leaving edges.

Beneficial effects that may be expected from a thin light film are:

1. Low commutator temperatures.
2. Low friction.
3. Satisfactory brush life.
4. Smooth brush operation.

Deteriorating effects that may be expected when the film is too thin are:

1. Rapid commutator wear.
2. Short brush life.
3. High friction.
4. Excess commutator maintenance (such as grinding and undercutting).

There are no predetermined rules that govern the ideal film to be desired for a given application and no personal preferences should be made as to whether a chocolate brown, or some other color will prove the most satisfactory. Bearing in mind the beneficial and deteriorating effects that may result from film variation as listed above, the following specific examples will illustrate the point. On a well adjusted machine where a relatively high contact drop is required for satisfactory commutation, the heavy dark film will provide best results, with good brush life and minimum commutator wear. In event the machine was so designed that the brushes would chatter, pick copper and run at high temperatures when a heavy film was formed, obviously the commutator should be operated with a light film. This should produce quiet operation at low commutator temperatures. Local conditions may occur such as the presence of oxidizing chemical fumes where it may be necessary to operate commutators, regardless of brush life or maintenance costs, with little or no film at all.

To conclude the matter of film preference; superior operation in most cases may be enjoyed when a relatively heavy film is maintained, provided there are no troublesome machine difficulties to be circumvented. In other words, longer brush life with minimum maintenance expense may be had when the film is as dark as is consistent.

FILM REGULATION

Should the commutator film stabilize at a point too thick or too thin and undesirable for satisfactory operation, the question arises as to how the desired quality may be produced. In event the film proves to be too dark and heavy, this case would indicate, as stated above, that the abrasive action of the brushes was insufficient to remove the material deposited by the negative brushes (on a generator) at a rate necessary to produce the proper film. The simplest means to correct this condition would be to apply brushes of a more abrasive grade. Where possible this may be done with results desired. However, in most cases where electrographitic brushes are used on the higher speed commutators, this corrective measure is not practical. When abrasive brushes are introduced on this type of application, the added abrasive also produces a higher brush friction that may be intolerable due to higher commutator temperatures, brush chatter, or other related ill effects. Some other methods used to overcome this difficulty and produce the film desired are as follows:

1. Increase brush tension when practical. This may also increase friction and commutator temperatures, but in some measure this is compensated for by a reduction in contact drop and may prove to be a complete solution of the problem.
2. Change to a brush of graphite grade. Abrasives may be added to this type material with negligible friction increase. On some applications where mechanical stresses are present this type of brush is not practical.
3. Add an arm (or more if additional abrasive seems necessary) of graphite (abrasive) cleaner brushes. This is often the simplest and easiest method of solving this problem. There are some cases where this is not practical, particularly where brushes operate radial or at a trailing angle, a higher friction may result by the graphite, electrographite film combination.
4. Apply a brush seating "stone." This will remove the excess film until sufficient time has elapsed for the layer to become stabilized.

There are a few cases where it may be difficult to build sufficient film that will provide the low friction and contact drop necessary for good brush life and satisfactory commutator operation. This condition may be attributed to one or more of the following causes:

1. Too heavy brush tension.
2. The presence of abrasive dust in the surrounding air.
3. Copper picking.
4. Brushes too abrasive.
5. Machine too lightly loaded.

As a rule film may be increased by decreasing brush tension, however, in some cases on machines operating at a full load, or an overload this cannot be done without causing selective action, (overloading and burning of some brush shunts). If such is the case it may be advisable to replace the brushes with a grade that has more film forming ability. If the source of trouble is due to abrasive dust the only method of correction is to eliminate the presence of dust at the commutator location. Continued copper picking will always be followed by loss of commutator film. This is caused by the abrasive action of copper imbedded in the brush faces. Upon examination of the brush contacts, in most cases, copper spots or a coppery sheen will be noticed. The absence of copper at the contact is not proof that picking is not taking place. Under some conditions the copper does not remain in the brushes but is pulled away, after a time, by friction upon the commutator bars. Where this has taken place, the brush faces will show a series of very thin streaks, starting at various points and continuing to the leaving edge. Copper dust particles will also be noted on the brush boxes and rigging. Copper picking may stem from a number of causes. To name a few; the brushes may be operating off the neutral plane causing excessive currents in the brush faces, too light tension, high frequency brush chatter, the brush arms may be improperly spaced, overloads, and particularly violently swinging overloads, or brush grade too low in contact drop. If the cause does not appear, obviously the machine should be checked electrically and mechanically. Satisfactory film cannot be formed when the machine load is insufficient to provide the negative brushes with enough current

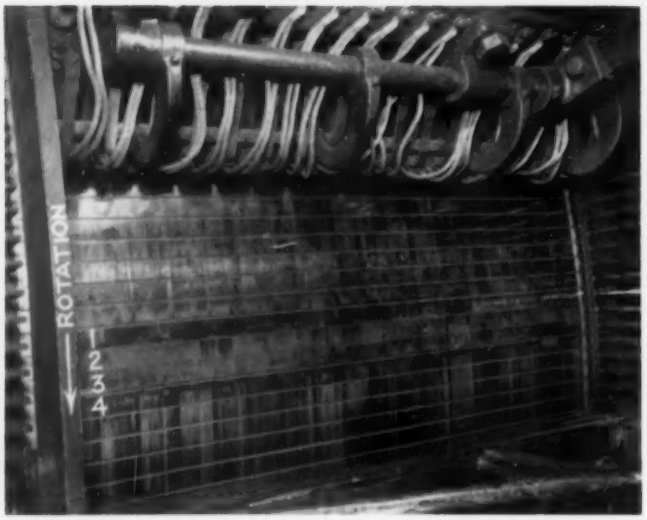


Figure 1 — Film pattern caused by a high resistance armature connection.

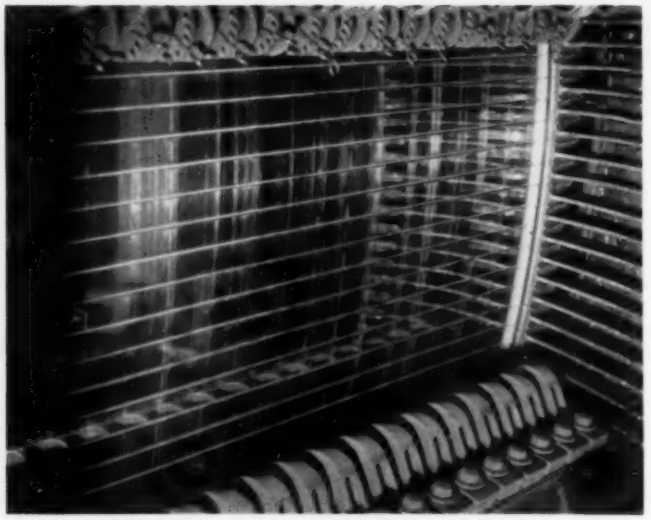


Figure 2 — A high friction glazed film may cause brush chatter.

to deposit adequate brush material on the commutator. This condition may be corrected by removing brushes until the required current is provided for the remaining brushes.

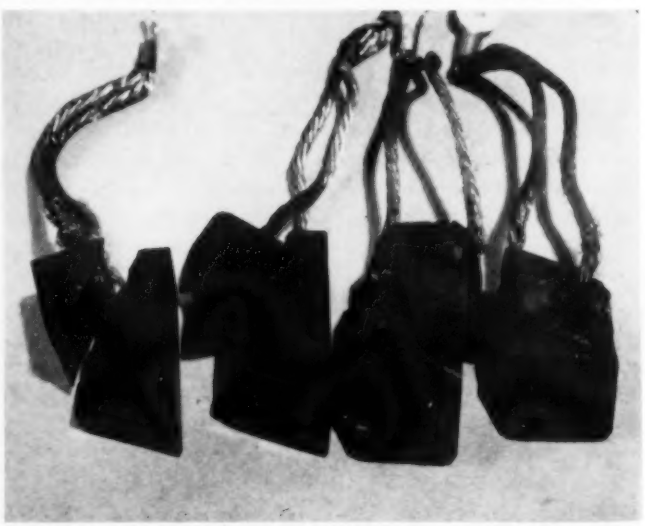
COMMUTATOR BAR PATTERNS

A casual observation of the commutator film at rest will reveal the presence of "high" or "low" bars by the difference in coloration. The cause of this difficulty may be of either mechanical or electrical origin. Due to the temperature differentials between adjacent bars, because of poor connection in the armature, low and high bars are produced in an otherwise mechanically smooth commutator. An imprint on a commutator film resulting from a poor radical connection is shown on Figure 1. This illustration shows a lap wound armature where the burned bars occur at only one point while on a wave wound machine the same indication will be observed at a distance of one pole around at least part of the commutator. Bars No. 2 and 3 are badly etched and burned due to mechanical disturbance exerted by bar No. 1, which is the high bar, having the defective armature connection. An examination of this film pattern reveals that the "good" bar (No. 1) is the one leading to the defective connection. It is difficult and sometimes impossible to determine by film observation whether the original cause is mechanical or electrical. A loose commutator bar will often produce a similar pattern to Figure 1. When the cause is mechanical, a number of other bars may show a like pattern, or a more positive indication is whether the imprint is more pronounced on one end of the bar than on the other and it will also be noted that there will be more vibration or "bump" on the brushes on one side of the commutator than on the other. The diagnosis of commutator troubles by film observation cannot be learned by explanation, each machine and set of circumstances will be somewhat different. It will prove profitable in every case to observe and note the film pattern when repairs seem necessary. By this simple method of diagnosis many engineers are able to prescribe the best corrective measures.

THE HIGH FRICTION FILM

The problem of brush chatter due to commutator glazing is not too often experienced, but this kind of film formation may present a vexing problem not easily solved. As may be seen in Figure 2 the commutator film presents an ideal appearance. The difficulty here is that the surface becomes too smooth, its quality can be detected by its mirror or lacquered finish. The high friction is caused by the action between the two highly polished or glazed surfaces of both commutator and brushes. The condition of the surfaces in relation to each other are critical. The chatter may be spasmodic changing with any external condition such as load or atmospheric changes. Situations have been noted where this type of brush chatter may be stopped or promoted by opening or closing the operating room windows. Figure 3 illustrates brush destruction caused by this class of high friction. Grinding the commutator or the application of a seating stone will afford only temporary relief, while a new glazed film has time to form. The addition of an arm of abrasive cleaning brushes may be

Figure 3 — Brush destruction was caused by glazed film.



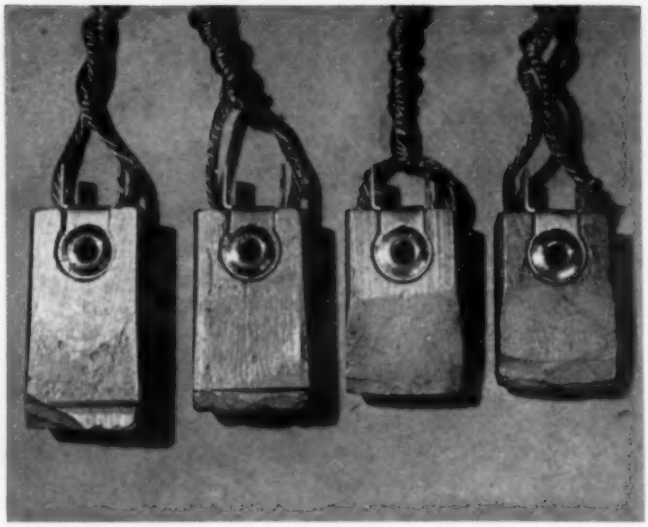


Figure 4 — Brush destruction shown was caused by mechanically imperfect commutator, brushes at trailing angle.

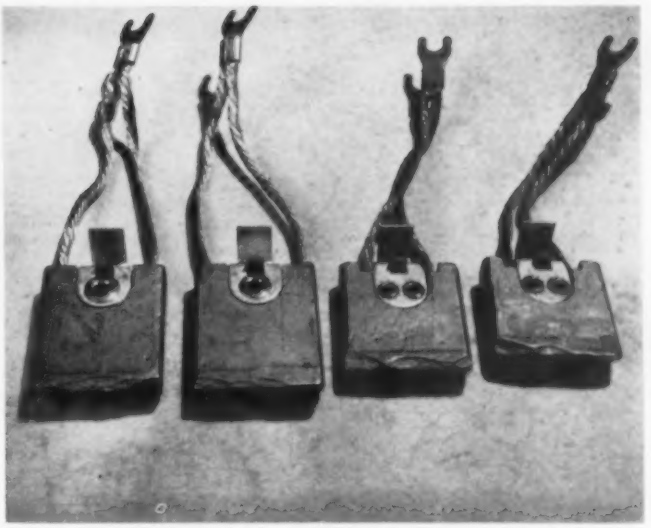


Figure 5 — Brush destruction shown was caused by mechanically imperfect commutator, brushes at leading angle.

a solution, provided they also do not form a highly polished contact surface and cease to become cleaning agents. Lighter brush tension where possible should be considered, also the possibility of altering the ventilating system. Where load conditions are very light, correction may follow the removal of some of the brushes. Some brush grades are prone to form glazed films more than others so a change in brush grade could bring about a solution of this problem.

THE EFFECTS OF LOW HUMIDITY

Some machine operators are of the opinion that they have never experienced brush trouble due to low atmospheric humidity. In some cases where local conditions are such that a small amount of moisture is added to the air this opinion may be correct. Where machines with peripheral speeds of 3000 fpm or higher are operated, low humidity difficulties may be periodically expected. The condition may be of a mild nature and noted, if at all, only by shorter brush life during winter months, when the lowest humidity periods occur. Under favorable weather conditions, a number of years may pass before disasterous conditions may be experienced, when, during a period of extremely low humidity, the brushes on some machines may be entirely worn out in a few hours and the brush rigging heaped with dust. The customary film on the commutator will have

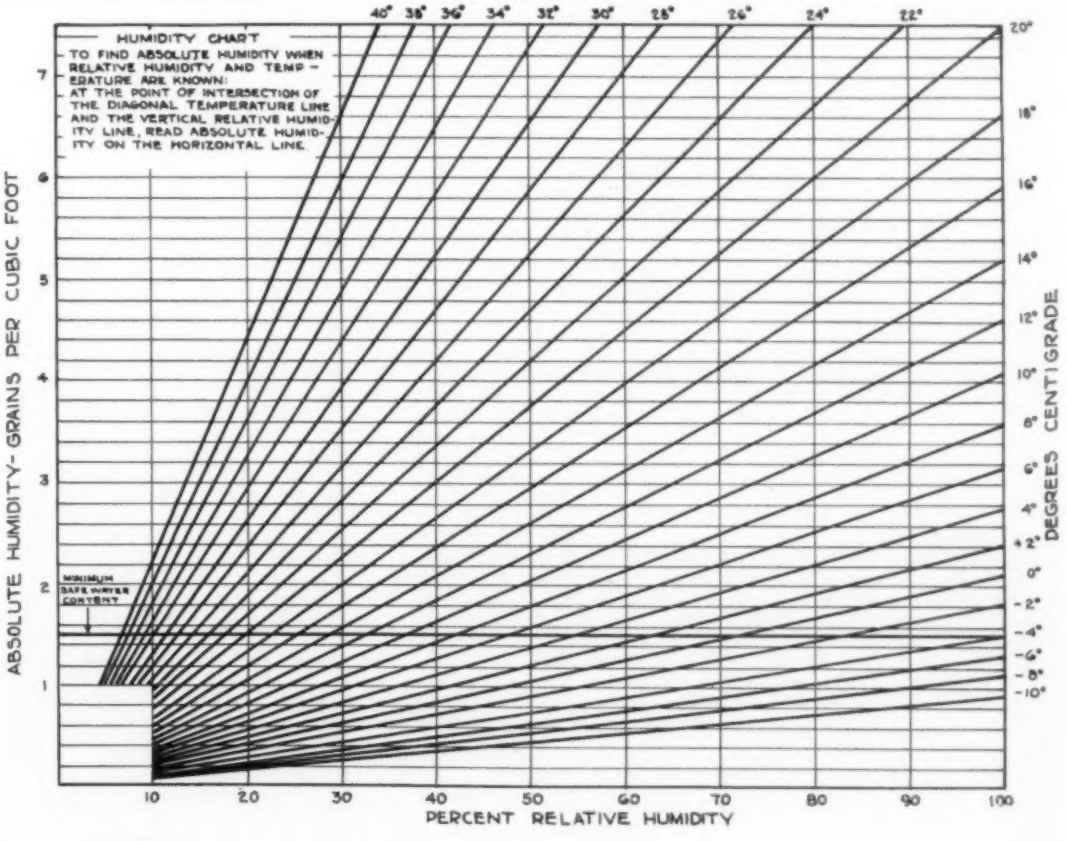

HUMIDITY CHART
TO FIND ABSOLUTE HUMIDITY WHEN RELATIVE HUMIDITY AND TEMPERATURE ARE KNOWN:
AT THE POINT OF INTERSECTION OF THE DIAGONAL TEMPERATURE LINE AND THE VERTICAL RELATIVE HUMIDITY LINE, READ ABSOLUTE HUMIDITY ON THE HORIZONTAL LINE.
MINIMUM SAFE WATER CONTENT
ABSOLUTE HUMIDITY- GRAINS PER CUBIC FOOT
PERCENT RELATIVE HUMIDITY
DEGREES CENTIGRADE
40° 38° 36° 34° 32° 30° 28° 26° 24° 22°
20° 18° 16° 14° 12° 10° 8° 6° 4° 2° 0° -2° -4° -6° -8° -10°
1 2 3 4 5 6 7
10 20 30 40 50 60 70 80 90 100

Figure 6 — Chart gives data for obtaining absolute humidity.

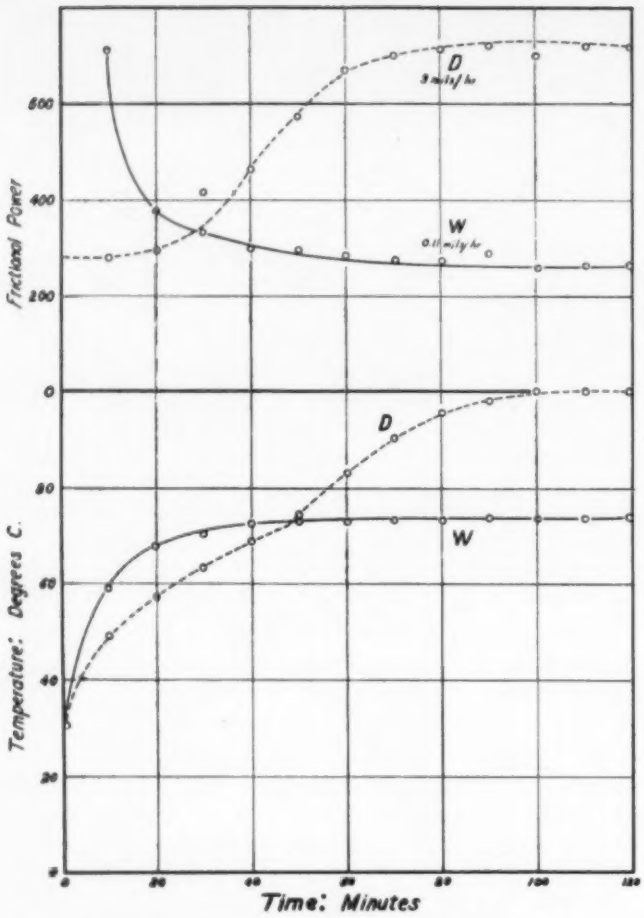


Figure 7 — Curves "D" show brush action at 0.3 gr per cu ft of water in air.

vanished and be substituted by a raw brassy color. The real cause of low humidity trouble is often overlooked, because of the unusually short duration of minimum moisture periods. The short brush life and rapid brush wear may be attributed to other causes, such as poor brush material, or faulty machine adjustment. The brushes may be changed or the machine adjusted and put back into service with satisfactory results because during the intervening time the weather would be likely to have changed and the humidity to have risen above the danger point.

Extensive research on the subject of humidity in relation to brush operation has been carried on at the Iowa State College at Ames. The result of this work reveals the following data of interest to the d-c machine operating engineer.

1. The critical wear point is a combination of temperature and absolute humidity.
2. A number of brushes operating together are necessary to reach the critical point (rapid wear could not be produced in the laboratory with two brushes).
3. The critical moisture point is reached at 2 gr of water per cu ft or less, depending upon the brush temperature.
4. All grades of brushes tested showed rapid wear at low humidities to a greater or lesser degree.
5. Rapid wear in low humidities could be produced without current, when heat was supplied externally.

Under normal operating conditions, the temperatures are such that a minimum absolute humidity of 1.25 gr per cu ft has been found to be within safe practical limits. There are no instruments available that read directly in water content. A hygrometer showing relative humidity together with a chart or tables such as shown on Figure 6 must be used to determine the water content of the air rather than its relative dryness as shown by the hygrometer alone. In Figure 7 are curves illustrating a typical laboratory wet (W) and dry (D) test run. The wet (W) being normal room humidity while the dry (D) is in controlled atmosphere of 0.3 gr per cu ft of moisture. After about 40 minutes operation the test ring has lost its film and both temperature and friction have started to increase. The brush life in normal humidity was 0.11 mils per hour while the wear on the dry test was at the rate of 9 mils per hour. This test was made with metal graphite brushes on bronze rings.

Figures 8, 9 and 10 are magnified photographs taken after a low humidity run with metal graphite brushes on bronze rings with a speed of 4200 fpm. Each of the three pictures are magnified about 55 times. Figure 8 pictures the ring surface showing a streak in detail. Figure 9 shows the furrowed contact surface of the metal graphite brush. Figure 10 illustrates the wear particles

Figure 8 — Ring surface shows streak after low humidity test.

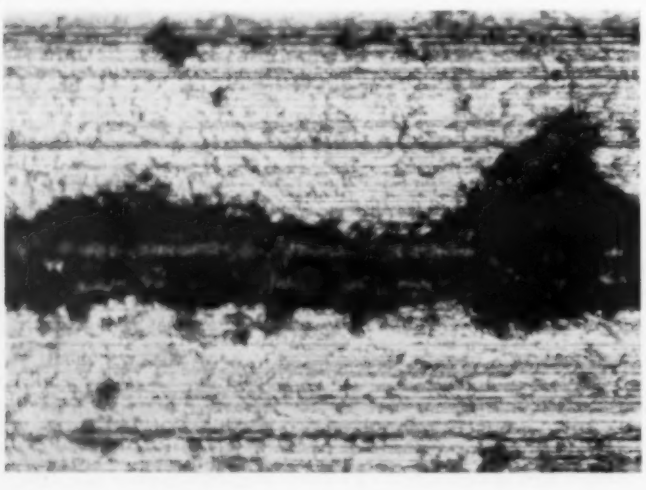
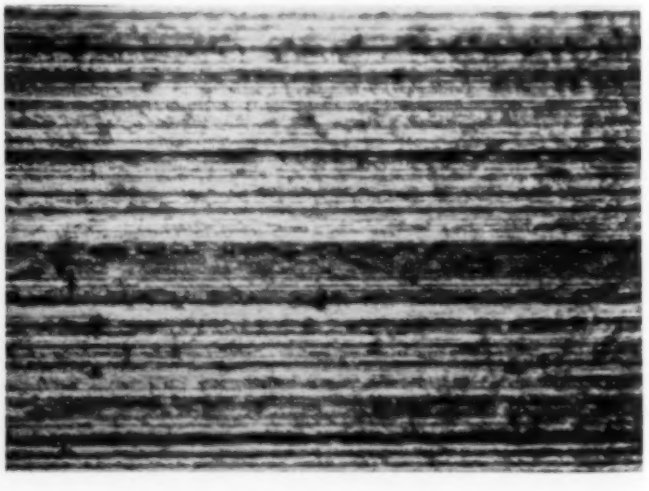


Figure 9 — Brush face is shown after low humidity test.



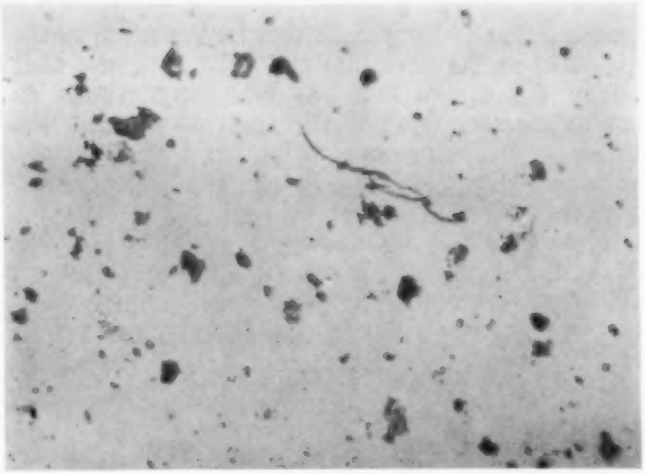


Figure 10 — Wear particles from low humidity test.

produced during the rapid wear period; note the rather long piece of copper furling.

The practical interpretation of this information seems to indicate that while some brush grades may be less affected than others by the absence of moisture, the only final solution of this problem is to provide some means of controlling low humidity. In many localities it should be economical to add water in the form of spray or steam to the air surrounding machines of large capacity.

DISCUSSION

PRESENTED BY

R. L. SEIDLER, District Manager, The Carbone Corp., Pittsburgh, Penna.

LEON D. COOK, Supervisor Substations, Commonwealth Edison Co., Chicago, Ill.

R. J. BEESWY, Electrical Superintendent, Inland Steel Co., East Chicago, Ind.

J. H. WAGNER, Electrical Superintendent, Acme Steel Co., Chicago, Ill.

M. S. MAY, Manager Service & Application, Speer Carbon Co., St. Marys, Penna.

N. F. BOWMAN, National Carbon Division, Union Carbide & Carbon Corp., Cleveland, Ohio.

S. S. CALLNER, S. S. Callner & Co., Chicago, Ill.

F. A. JOHANTGES, Electrical Engineer, Wisconsin Steel Works, International Harvester Co., Chicago, Ill.

E. P. SMITH, Design Engineer, General Electric Co., Schenectady, N. Y.

C. C. SITTLER, President, Sittler Corp., Chicago, Ill.

E. H. MYERS, Manager Standard Machine Section, Generator Engineering Department, Westinghouse Electric Corp., E. Pittsburgh, Penna.

R. L. Seidler: Mr. Cook's paper has clarified a subject that has been of great interest and importance to the electrical division of the steel industry. He has explained some of the fallacies concerning commutator appearance that have been the subject of discussion for years. The information presented should be helpful to all.

In line with Mr. Cook's statements on methods of film regulation we have recently used one other method of obtaining film stabilization. This is a system of using split or sandwich type brushes, one half of which is graphite and the other half electrographitic. We have used a graphite material for the entering half brush and electrographitic on the leaving half of the brush, combining good film forming and regulating properties of both materials in a single brush holder.

We shall be interested to have Mr. Cook's thoughts on this.

Leon D. Cook: We have had some experience with the use of the sandwich type brushes with graphite on the leading half and electrographitic in the trailing. This is indeed an easy and a practical way to solve the difficulty of bothering with the application of cleaning brushes on some brush arms. I will agree that this is a very successful and practical way to add cleaning action for proper film control. This method is very effective but more expensive than the use of standard cleaning brushes for the additional abrasive.

R. J. Beeswy: It is agreed that correct film will produce ideal commutator conditions, but we have seldom been able to reach this desired perfection. This is because it usually takes ideal conditions to produce such a film, which are continually being upset by varying loads, humidity, temperature and other atmospheric conditions including dirt and gases in the air and possibly even a variance in manufacturer's brush grade.

I would be interested in hearing how Mr. Cook applies his theory to reversing drives like blooming mills where the polarity changes for each reversal. Also on machines with widely varying loads like strip mills.

We also agree that many commutator conditions are due to faults in machine design and some to internal troubles in the machine itself. For example, one of our blooming mill main drive motors which had a perfect commutator for 20 years developed burnt and discolored bars. The commutator was ground, the slots undercut and cleared of feather mica and beveled. Still the trouble re-occurred. Closer inspection and testing revealed a high resistance connection in one branch of a parallel interpole circuit.

We, at Inland have had good operating experience by occasionally using a fine stone on commutators that tend to develop films which cause brush chatter. This light stoning keeps commutators round and prevents grooving.

Leon D. Cook: In my opinion there should be little difficulty in keeping film from becoming too heavy on reversing drives with radial brushes, for during the reversing cycle some copper picking should take place and form some abrasive. Should cleaning action be necessary I see no reason why abrasive graphite brushes as cleaners should not be successful as on any other radial brush application.

As I have stated, cleaners or abrasives of any kind are difficult to operate on 15 degree trailing or radial brushes.

The use of a fine grinding stone to maintain a desired commutator film is effective and may be necessary where a proper brush grade or combination of grades, cannot be found to do the job properly. The only difficulty

here is the bother and expense involved in having to have someone do the grinding at frequent intervals.

John H. Wagner: We have experienced some of the difficulties mentioned by Mr. Cook in his paper. To mention a few: we had trouble on rotary converter slip rings due to low humidity which we cured by discharging a fine jet of steam into the room. Humidity was 15-20. The steam jet raised it to 35. We also corrected a condition caused by light loading on a generator by removing half the brushes.

I would like Mr. Cook to tell us something about the problem of copper dragging and slot filling with copper foil.

Leon D. Cook: There are times when it is just about impossible to prevent some copper dragging and slot filling. Where conditions are such that a thin film must be maintained with rather heavy brush tension, slot filling is very likely to follow. In order to delay this action as long as possible I would recommend:

1. Widen the commutator slots by chamfering the bars, half the contact surface of the bar may be cut away in most cases with satisfactory results.
2. Use as light tension as practical.
3. Either by machine adjustment or brush application prevent copper picking or brush chatter.

M. S. May: Mr. Cook deserves thanks for having described the commutator film effect in detail. It is probably the most important feature in brush operation and it is one of the last features that we have now quite some data on.

The Commonwealth Edison Co. deserves a great deal of credit for having brought up this matter early in the game. If I remember correctly it was around 1930 that Mr. Cook called attention to this action. At that time it was difficult to realize that the humidity of the air was principally responsible for the results obtained. Chicago being on the shore of Lake Michigan with the lake near by could hardly be pictured as a city with lack of humidity.

Mr. Cook's colleagues in New York, the Consolidated Edison Co., had similar experience only in another direction. For years the men in the Edison Company would always run the rotary near the front door, and open the front door of the substation when it was raining, with the result that machines sparked less and made less noise on account of the reduced friction. Laboratory tests subsequently proved that there is a definite moisture content, below which brush wear increases materially.

You all know that during the war with operations at high altitude this very problem became very important and the brushmakers had to spend a great deal of money in order to get the necessary brush life on a brush when it was operating in thin cold air at 30,000 to 60,000 ft altitude. This is again the loss of film due to lack of water in the air.

A heavy film that is very black and apparently high in friction is caused by sulphur in the air, put into brushes or even in a commutator stone.

The ideal film is apparently a thin one that is low in friction and reasonably conductive. Its color varies widely depending on many factors. I am glad that Mr. Cook emphasized this point as many electricians have worried unnecessarily about the color of their commutators.

N. F. Bowman: I want to congratulate Mr. Cook upon the practical approach that he has made to the subject of commutator film and what it means. It is usually difficult to translate laboratory results on dummy commutators and slip rings where most film studies are made, in terms of large real commutators, but here we have the actual observations over a period of many years of field operating experience. From this standpoint there is little that can be added to what Mr. Cook has said but I appreciate this opportunity to elaborate on some of the points he has made. From the standpoint of brush application, his comments with regard to the characteristic color of the film on an individial machine are especially pertinent. It frequently happens that a grade of brush that gives the most acceptable performance otherwise does not produce the exact color or uniformity of color that the operator may prefer, and Mr. Cook's discussion goes a long way in explaining why this is so. In many cases it is difficult enough to produce a film of the nature that is desired without regard to color, and the ultimate success in the solution of commutator filming difficulties is often dependent upon the amount and frequency of attention that can be given to the individual machine involved.

Commutator film is a very complex thing and when the machine is running the commutator is in effect a large color wheel on the surface of which are blended the various colors and markings of the individual bars. When the armature is at rest, however, the component color elements may be examined separately and their cause and possible means of correction considered. For instance, a commutator which may appear too dark and has taken on a blackened color while running may, when shut down, turn out to have a very satisfactory color and polish over most of its area, but exhibit badly blackened bar edges on every third or fourth bar as is occasionally experienced with three or four coil per slot armatures in the presence of slight maladjustment or excessive overload. In such cases our concern is not with the commutator film in general, but with the blackened edges of the third and fourth bars which have built up an excessive amount of film. The remedy under some conditions may be to resort to a brush of greater commutating ability, but where this choice is not possible, the most desirable remedy is to select a brush that will remove the excess film deposition at the trailing edge of these third and fourth bars at about the same rate that it occurs thus preserving a more uniform commutator film and color over all bars continuously.

With electrographitic brushes it is frequently possible to overcome such conditions by the selection of grade having a mild polishing action and even on higher speed commutators this is practicable when load and other operating conditions permit. In other cases, resort to graphite cleaner brushes, as mentioned by Mr. Cook, may be necessary, and such means will usually produce the desired results if the operator can give the time and detailed attention to the individual machine where such a remedy is applied.

For other symptoms different remedies must be used and in some cases, of course, the evidence is clear that electrical or mechanical faults must be corrected before a satisfactory film condition can be preserved. In this connection I heartily endorse Mr. Cook's statement that "the diagnosis of commutator troubles by film

observation cannot be learned by explanation" and it is by years of experience in making such observations and applying the indicated remedies that successful techniques for correcting such difficulties with existing brush materials can be worked out and that improved brush materials can be provided for the future.

In addition to the electrical and mechanical features that can complicate brush performance and commutator film, the effects of electrolytic action or electrolysis are becoming more and more recognized and in many cases may explain those disturbing commutator conditions not directly accounted for by the apparent local operating and atmospheric conditions.

Except for the attention that has been given to the operation of brushes on military planes at high altitude during the past few years, the successful operation of carbon brushes on copper commutators has been left largely to natural conditions. In this respect it is fortunate that most kinds of carbon brushes on commercial copper commutators operating at ground level in the presence of prevailing atmospheric conditions in most localities give very acceptable performance as far as brush life and commutator conditions are concerned. In a relatively small percentage of cases, however, some local cause in the adverse film conditions Mr. Cook has discussed and special attention is required.

For some time now our company has been working on the technical control of commutator film by the introduction of chemical or other agents that will establish and maintain satisfactory commutator film throughout the life of the brush. These efforts have met with considerable success and I hope I am not looking too far into the future when I say that these materials will eventually be commercially available to the steel and other industries, and their application will result in improved performance on normal as well as troublesome machines.

S. S. Callner: In Mr. Cook's discussion on film regulation he mentions the application of a brush seating stone, or as it is commonly called a commutator cleaning stone. I wish to also mention another type of stone. It is known as a flexible abrasive and contains a very fine abrasive held together with a flexible bond, usually latex.

I would like to describe the action of both the common commutator cleaning stone and the flexible abrasive. The cleaning stone is made of a soft chalk-like material that wears away for self-cleaning. The excessive film is removed by the minute particles which wear away from the stone and actually rolls between the brush and the commutator. It also has a cleaning action on the brush face and will cause slight wearing of the brush. This may be very desirable as it removes some forms of glazing from the brush face. The flexible abrasive cleans like an eraser and has the advantage of generating practically no dust. It does not affect the brush face.

The use of the flexible abrasive has developed very much in the past few years and has replaced the commutator cleaning stone to quite an extent, especially in the steel mills and the railroads. I might mention here that the subject has been discussed quite extensively in a handbook on commutator and slip ring maintenance, written by the author of today's paper, which is excellent reading for apprentices.

Leon D. Cook: From a commutator cleaning standpoint I will agree the latex abrasives are as effective as the chalk stone without the annoyance of dust. In cases where it is desired to renew the brush contact as well as clean the commutator, this type of material is not satisfactory and the chalk stone must be used.

F. A. Johantges: This paper indicates that film of some kind is essential to good commutation and brush life. We immediately then want to know how to obtain the right kind of a film in the least amount of time. Since this may be as long as 10 days, are there not some artificial ways to aid in the forming of film, such as special brushes or periodic application of polishing equipment like a heavy piece of canvas?

Naturally we would all like to have the medium-colored commutator, but if the coating becomes too heavy by the time that the equilibrium is established, we must resort to abrasives, increased brush tension, or change the grade of brush. Our experience has been that best results are obtained by changing brushes. Cleaner type brushes have only given us temporary relief. We have had good results in removing some brushes on lightly loaded machines where the brushes were chattering and breaking.

Mr. Cook speaks of the highly glazed commutator as causing brush breakage and high temperatures. We have not experienced this trouble — these are our best operating machines.

The section of this paper that deals with the low humidity difficulties is interesting. Is this a theory, or has there been some actual experience in the steel mills? How can humidity be controlled in the non-ventilated enclosed machines?

Mr. Cook has suggested a number of ways to improve brush life and commutation, and even though there is no easy way to cure our troubles, we can benefit from these suggestions.

Leon D. Cook: There is no way that I know of to speed up film formation. To use brushes of more film forming properties may result in a film too thick for practical use.

Your statement about your experience with glazed commutator film is undoubtedly correct. In most cases these will be your best applications, but when conditions are just right, a very high friction may result as outlined. The example I gave was on a commutator that had operated with an ideal film for the past 12 years, the load was reduced about 15 per cent when the glazing condition started. Brush destruction due to low humidity is no theory, I have seen the results many times. Yes, there has been humidity trouble reported in steel mills. To humidify, where possible release steam into the room where the machine is operating.

Edward P. Smith: The importance of commutator film must be understood by operating and maintenance personnel if the d-c machine is to operate properly. The best of designs will fail to commutate successfully if the brush does not develop the correct film on the commutator. There is an ever present conflict between the brush manufacturer and the machine manufacturer as to whether the brush or the machine design is the cause of commutation difficulties. The brush cannot correct poor machine design, and likewise the best machine design cannot perform successfully with improper brush application. The commutator film will permit the engi-

neer to distinguish between incorrect machine adjustment and improper brush application.

The author refers to the experiments made by Dr. Hesler and his associates at Iowa State College but makes no other references. Is it to be assumed that all other data is from original experiments performed by the author?

In the section on "The Effects of Low Humidity," Item 2 states parenthetically that "rapid wear could not be produced in the laboratory with two brushes." This statement is questionable since small aircraft generators with only two brushes have dusted both in the laboratory and in the field.

In Item 4 of this same section, the author does not specify what grades of brushes were tested. Certain chemicals can be added to brushes, including metal graphite grades, which will compensate for the lack of moisture. Tests have been made to prove that these chemicals will eliminate or reduce the rapid brush wear. So whenever conditions warrant, these brushes can be used instead of humidifying the atmosphere.

The commutator bar pattern section of the paper deals only with types of patterns related directly to the commutator such as defective armature connections and loose commutator bars. Recently, a number of commutation problems had one common characteristic, which was a commutator bar pattern of several burned bars together in a group and each group located two pole pitches apart. After considerable study, the solution was found in improper coupling alignment even though the vibration of the machines was very low. Thus, bar patterns may be caused by improper mechanical adjustments far removed from the commutator.

The author states that abrasive dust is troublesome in the formation of commutator film. For a number of years, we have fluted the face of the brushes to decrease the effort required to fit the brushes to the commutator. The fluted brush has proven to have other inherent characteristics. One of these is its ability to develop a stable commutator film in the presence of construction dust. Apparently, the flutes permit the abrasive dust to pass through the brush without going between the brush face and the commutator. The source of dust must be removed for continued successful operation after the flutes have worn off.

Leon D. Cook: Possibly I was not clear in stating that all the laboratory data was taken from reports from the work done on humidity and brush operation at Iowa State College.

At the time it was not possible to produce rapid wear with two brushes because the temperature was too low due to the ready heat dissipation with only two brushes. When additional brushes were added due to higher temperature, it was possible to produce rapid wear. Brush destruction on two brushes was produced in the laboratory when heat was added by external means. I understand the generators you speak of do operate at rather high normal temperatures.

I do not remember the specific grades used in these tests, and it was not thought proper to publish the manufacturers grades by name. However, the leading grades from most of the brush manufacturers were used for the tests.

We have used on the rings of 13000-amp, 250-volt rotary converters some of the chemically impregnated grades that would compensate for lack of moisture. These brushes ran such a heavy film during normal humidity that they were found to be impractical for normal use. Where it would be possible and practical to change brushes during low humidity periods, no doubt this type of brush could be used with success.

Carl C. Sittler: I will attempt to emphasize certain points which Mr. Cook has brought out in this most able discussion and, based on long experience in the brush business, recommend that you carefully study this paper and use it as a text in training your men.

Commutator film is an elusive thing, changing with the winds. Blow cigarette smoke on the commutator of a miniature d-c shunt motor running at no load and the input current will drop appreciably. Here the brush friction loss is a high percentage of the total loss, so changes in brush friction are easily measured. Replace the air surrounding an equipment using brushes with nitrogen and in a few minutes the brushes start to dust rapidly.

With no other lubricant present, a sliding carbon demands water to maintain low friction. Mr. Cook has shown how this was proved with metal graphite brushes in the college laboratory. Most operators are convinced by experience or by the literature on the subject that more wear takes place on both carbon and metal graphite brushes during periods of low humidity. Perhaps many do not know that carbon also demands water in mechanical applications. The success of face type rotating shaft seals is largely due to the ability of carbon to rub against a super-finished metal mating ring at high speeds, maintaining a contact so intimate as to prevent leakage of gases like freon and yet not seize or gall. Operating under given conditions of pressure and speed, and sealing water the carbon ring will operate 1000 hours with hardly measurable wear; sealing air at room temperatures gives some wear but reasonable life; sealing air at 250 F and therefore driving all moisture out of the carbon will result in very rapid wear taking place. Carbon has a great affinity for water, and as previously stated in the absence of moisture, friction increases. Little note was taken of this fact and little research done to overcome the disastrous results experienced because of it, until aircraft carrying electrical equipment using brushes began reaching the rarefied atmosphere and moisture of altitudes over 20,000 ft. Certain lubricants added to the brushes gave satisfactory life up to 25,000 ft. Now, brushes are asked to operate at 50,000 and even 75,000 ft. Reasonable brush life is obtained by the addition of various chemical compounds either in the mix or by impregnation. As Mr. Cook pointed out, it is difficult to stabilize the commutator film on a machine subjected to the atmospheric variations in a fixed location. How much more difficult to stabilize a film on equipment that must operate in the Arctic, the stratosphere and in the steaming atmosphere on the ground at the equator. Of course a compromise must be accepted.

These additives used in aircraft equipment brushes are finding some success on power equipment applications and I predict you will hear more about them.

Perhaps I am old fashioned but I still like graphite brushes. They are excellent in many cases on continuous loads up to 60 amp per sq in. and certainly superior on direct connected exciters on turbo-generators. They

seem to have gone out of fashion with some but there are many beautiful commutators that have been under graphite brushes for more than 20 years. Use of so-called cleaner brushes is the only way to vary the brush action to meet the varying load and atmospheric conditions. Of course you can change the complete set each time the commutator becomes too dark or too light. I know all of the arguments against the practice but I am still convinced it gives maximum efficiency on large equipment.

The high friction glazed film Mr. Cook mentions is often caused by a hard highly bonded brush. Sometimes a graphite brush will correct the condition. If not, the use of a loosely bonded brush is indicated. As tiny particles break away at the surface they form ball bearings between the face and the commutator. Several manufacturers offer such material and it is well worth consideration.

E. H. Meyers: We are indebted to Mr. Cook not only for an informative paper on a subject that has plagued mill operators since the first use of d-c machines, but for shaking firm convictions that only a certain type of commutator film was ever acceptable. It seems that no two engineers ever agree about the proper commutator film, as some like them "bright" and some like them "black," but whatever they like they usually are firm and consistent about it. Mr. Cook's paper should help us to be more realistic.

It is unfortunate that Mr. Cook did not have more time to devote to the effects of oxidizing chemical fumes on commutator films. This is one of the most difficult problems facing those who are responsible for maintaining d-c machines in steel mills. It has been shown that as little as one part of hydrogen sulphide in 35,000,000 parts of air can cause the copper oxide film on a commutator to lose its protective qualities.

Almost every operator finds, sooner or later, that some of his commutators are covered with the sticky black film due to this gas. As a result, the brushes chatter and commutation is poor. Finally the film breaks through at several points causing selective action and threading and grooving. Since steel mills are notorious for having hydrogen sulphide, chlorine and ammonia fumes in the air, Mr. Cook's experience in coping with those contaminants would have been very interesting.

Steel mill designers are beginning to recognize the importance of this problem and try to avoid piping in ventilating air subject to direct contact with such fumes from coke ovens and other types of furnaces. However, no complete solution has been found, and study of methods to remove the gases by such means as water baths, charcoal filters and other ways is justified. The use of a sufficiently abrasive brush to scrub off all films does not seem to be a proper final answer. Yet, since the effects of the fumes will vary with humidity, wind direction and temperature, the use of compromise brushes to leave a satisfactory stable film appears very difficult, if not impossible.

In regard to the impossibility of obtaining rapid brush wear due to low humidity when only two brushes were used, we would like to suggest that this indicates that perhaps the actual cause of excess wear in low humidity is due to selective current action. Perhaps one brush breaks through the film causing intimate contact with the result that that brush "hogs" the load current from the others for a period when there are many brushes in parallel. Then another brush would do the same thing. This, of course, would not be possible when there is only one brush to carry current in and another to carry it out.

Leon D. Cook: In the laboratory it was not possible to obtain rapid wear with only two brushes when operated at normal current densities. However, rapid wear could be produced by introducing heat by means of an external heating coil. This would seem to bear out Mr. Myers' theory that selective action may be the underlying cause.

We have found on testing current distribution on normal operating copper graphite ring brushes that some brushes were carrying 200 to 300 per cent overload most of the time. This condition could produce the heat necessary to start brush destruction.

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ASSOCIATION OF IRON AND STEEL ENGINEERS, 1010 EMPIRE BLDG., PITTSBURGH 22, PA.

CASTABLE REFRACTORIES IN THE STEEL MILL

By J. D. McCULLOUGH
Chief Engineer
Refractories Division
The Babcock & Wilcox Co.
New York, N. Y.

. . . . speed and economy in applying refractory castables make inevitable their increased acceptance for steel plant uses . . . .

▲ ONE of the most significant trends of the postwar years has been the increasingly rapid adoption of castable refractories in place of fired refractory shapes for furnaces commonly used in various phases of the manufacture and processing of steel.

Because of a confusion in terms, it is pertinent at this point to clarify the distinction between plastic refractories and castable refractories.

Plastic refractory is the term applied to an unfired plastic fireclay which may or may not contain some calcined fireclay and which has been tempered with water by the manufacturer to make it suitable for ramming into place, a process normally accomplished with a hand mallet or air tamper. The average plastic refractory possesses relatively low air dried strength and depends primarily upon exposure to heat to develop a high strength.

A castable refractory — often referred to as a refractory concrete — is a material consisting of a combination of calcined clays and raw clays (which serve as the aggregate) and a hydraulic binder, or cement. It is shipped dry; water is added at the job site and the material is mixed and placed in a manner similar to structural concrete. Because of a chemical reaction between the water and binder, it develops a very high air dried strength, which may increase with time. It does not require exposure to heat in order to attain a high strength.

There is a wide range of castables on the market having various refractory bases and ranging in weight from 50 to 175 lb per cu ft.

This discussion is confined to castables having an alumina-silica base and having densities on the order of 125 lb per cu ft dried weight.

There are many reasons for the trend towards the use of castables. A few of these reasons are listed below:

1. Shortage of skilled masons.
2. Reduction of inventory of special shapes.
3. Elimination of expensive cutting and fitting of brickwork.
4. Savings in time of installation.
5. Savings in cost of installation.
6. Lower maintenance.
7. Availability of improved volume-stable refractory castables suitable for temperatures up to 3000 F.

PROPERTIES

What are the principal properties of a refractory castable in which the user is interested?

1. It must be capable of withstanding the temperature conditions and operating cycles without excessive cracking, shrinkage, or bloating; i.e., it must be volume stable.
2. It must not disintegrate, when exposed to high sulphur fuels and reducing atmospheres.
3. It must possess adequate strength.
4. It must have a satisfactory resistance against spalling.
5. It must be easy to install.

Inspection of test data will sometimes make it possible to eliminate materials obviously unsuited for specific applications. In many instances the best criterion for selection of the most suitable material is comparative service trials.

THERMAL CONDUCTIVITY

Based upon results obtained in our laboratories, it has been found that the thermal conductivity of a castable refractory depends upon the physical state of the material as it goes through various temperature ranges. To understand why this is so requires a brief explanation of what happens to a castable under heat. In the cold state, a certain amount of the water which is added to the castable reacts with the binder and is captured as water of crystallization. At certain temperatures — above 1000 F — the water of crystallization is driven off, creating a system of fine pores which produces an insulating effect. At still higher temperatures, vitrification of the clays takes place, tightening up the structure and increasing the ability to conduct heat.

In a typical installation the exposed face may be at a temperature sufficiently high to bring about vitrification for a depth of several inches, and in this zone there may be a relatively high thermal conductivity. The next few inches may be in a non-vitrified temperature zone where the water of crystallization has been driven off, and because of the system of pores thus established, the thermal conductivity in this zone will be lower than in the zone of vitrification. The final few inches may be in the zone under 1000 F where the thermal conductivity is higher than the intermediate zone because of the denser structure. Thus the over-all thermal conductivity is dependent upon the temperature gradient through the castable.

INSTALLATION

In general, it may be stated that sound installation practice of structural concrete will result in a good installation of a castable refractory. Unfortunately, many installers are not completely familiar with all of the factors affecting installation of concrete. A few highlights are being touched upon in this paper.

There are four stages in a castable installation:

1. Mixing and placing.
2. Curing.
3. Drying.
4. Firing.

We shall treat each phase separately.

1. *Mixing and placing* — Castables can be poured into place or shot into place by a suitable type of gun. If poured, they can be mixed by hand or can be mixed in a cement mixer or a mortar mixer. Economic considerations and availability of equipment are normally the determining factors in selection of method. To avoid contamination of the castable refractory, it is important to use clean water and clean equipment.

To obtain the strongest structure the water content as recommended by the manufacturer should be used. Too little water may result in a porous structure which cannot be worked into place. Too much water will result in a definite loss of strength. The material should be worked into place thoroughly to eliminate entrained air and to completely fill in the corners, etc. A refractory castable should not be installed in freezing weather without first making provisions to keep the material from freezing. Freezing of the castable will result in an inferior installation. It is desirable to maintain a temperature of 60 F-70 F, if possible.

2. *Curing* — The term curing, as applied to a castable, means keeping the material wet or the surrounding atmosphere humid. The primary purpose is to create the most favorable conditions for the completion of the chemical reactions. Normally, a period of 12-24 hours is suggested. A properly cured installation will normally be stronger than one which has not been cured. However, we are all familiar with successful castable installations which were placed in service without benefit of curing. The reason may be that the *extra* strength which the curing imparts was unnecessary. On the other hand, some castable installations have been made without benefit of curing which have not been satisfactory. Proper curing on such jobs might be the difference between a satisfactory and unsatisfactory installation.

3. *Air drying* — Following the curing, the material may be exposed immediately to heat, or it can be air dried indefinitely. The longer it air dries before exposure to temperature, the more strength it will develop, although the increase in strength usually is negligible after several days.

4. *Firing* — The manufacturer's recommendations should be followed regarding firing-in procedures. With some materials, the heat may be applied very rapidly, and with others a slower heating schedule may be recommended. Also, the mass involved and means for the escape of free moisture may have a bearing on the safe firing rate.

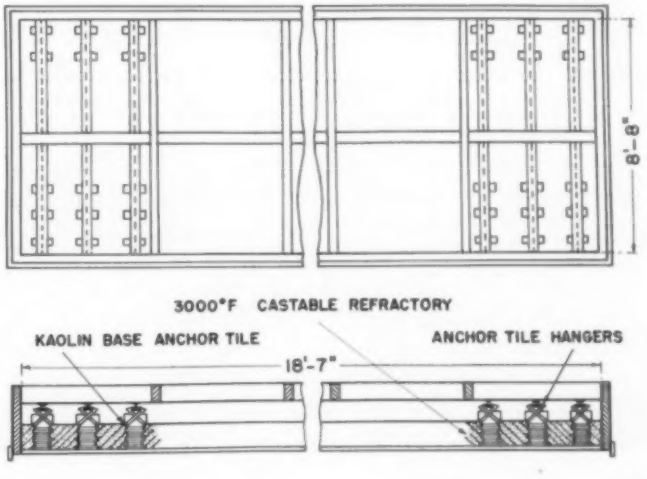
TYPICAL APPLICATIONS

Having covered briefly the properties of, and installation procedures for, refractory castables, let us look at some of the places where they are being used.

A group of various types of installations is covered in the following descriptions. They are all made with a volume-stable 3000 F kaolin base castable characterized by a high alumina-low iron hydraulic binder which has proved itself on a number of installations to be unaffected in the presence of high sulphur fuel and reducing atmospheres.

1. *Soaking pit covers* — Soaking pit covers are frequently a high source of maintenance. Because of unusual stresses, manner of operation of handling equipment, age of equipment, or for other reasons, refractory

Figure 1 — Castable refractory lined soaking pit cover. Castable is poured between suspended anchor tile.



maintenance costs with conventional constructions have in many plants become so critical that a departure from conventional methods of construction have had to be considered.

a. Several years ago, one of the large mills in the Pittsburgh area found itself faced with such excessively high maintenance costs that a completely new approach to the maintenance problem was deemed necessary. The pits are recuperative and are end fired, burning a mixture of coke oven and blast furnace gas. The size of the cover is 18 ft, 4 in. × 8 ft, 5 in. inside the frame, equivalent to 155 sq ft.

A monolithic construction was tried and proved to be successful in reducing maintenance. The construction originally employed required that the cover be set on end, formwork installed, and that the material be hammered into place. The average installation required 120 manhours, or 1.3 sq ft per manhour, not including formwork. In an effort to eliminate the formwork and to reduce the installation time, it was decided to try refractory castables.

The first two castable refractory covers were installed August 1950. The construction is shown in Figure 1. It consists of suspended corrugated anchor tile suitably spaced, between which a refractory castable is poured A permanent concrete form built on the floor at one end of the soaking pit building can be used for all covers of the same size.

To install such a cover the form is covered with waterproof paper, the cover is placed on the form in its natural operating position, the tile are placed into position and tightly wedged, and the castable is poured. A cover of the size shown has been installed in a period of 2¼ hr with a six-man crew using a mixer handling

Figure 2 — Gunned soaking pit covers show cover on left ready for gunning, and cover on right after gunning.

a 600-lb batch or at the rate of 11.5 sq ft per manhour. Practically speaking, the crew would spend a half day on the job, resulting in an actual installation rate of 6.5. sq ft per manhour as compared to 1.3 sq ft per manhour for the previous construction.

The castable cover has thus proved itself highly successful in reducing installation costs. It has proved itself equally satisfactory from a maintenance standpoint. The two original covers are in excellent condition after two years' life, and two additional covers have

Figure 3 — Cover is being gunned. It is advantageous to place material in horizontal position.

since been installed. To date there has been no maintenance on any of them.

b. A second method of application to this type of construction is by gun. Figure 2 shows two covers, one of which is ready for gunning and one of which has been completed. For this application, the cover is turned upside down, the tile are placed and wedged in position, and formwork is installed at the proper depth from the bottom of the cover. This permits the material to be placed under the most advantageous conditions. Figure 3 shows the material being gunned. A five-man crew was able to accomplish the actual placing of the material on one cover of 80 sq ft in 35 minutes, or at the rate of 27 sq ft per manhour. To this figure, however, must be added the time required for formwork, getting ready, cleaning up, etc., which brings the rate per manhour more in line with casting methods.

c. Covers of sprung types have also been installed with castable refractory. Experience at several plants has indicated that it may be desirable to incorporate an anchor support to reinforce the natural sprung arch action.

2. *Soaking pit walls* — Soaking pit walls are also a source of high maintenance in many plants. This can be due to (1) ingots striking the walls, resulting in immediate gouged areas and resultant loosening of brick; (2) sand from the seals working down through the brick joints, resulting in separation of brick; (3) alternate heating and cooling of the brick, resulting in working them out of place; (4) a combination of the foregoing, with other unmentioned causes contributing to a relatively short life.

A monolithic construction eliminates many of the weaknesses mentioned above, and a castable refractory

lends itself to easy, economical, and rapid installation of a monolithic construction.

a. About three years ago this castable was tried for patching purposes at the skew line of a circular type soaking pit. Experience had shown that replacement brick would not give as good a life as the original installation. The use of castable in this location proved to be the answer to a difficult maintenance problem. The castable provided a tighter job than could be obtained with brick. Also it developed in service that an ingot, on being withdrawn, might accomplish some local gouging, but did not affect the stability of the structure. With brick shapes on the other hand, a localized loosening of the brick in the immediate area would result, and periodic maintenance was a necessity.

b. There are a number of individual walls of refractory castables in soaking pits, but one of the most interesting installations consists of two pits with all four walls of refractory castable.

These pits are of the recuperative, center-fired type

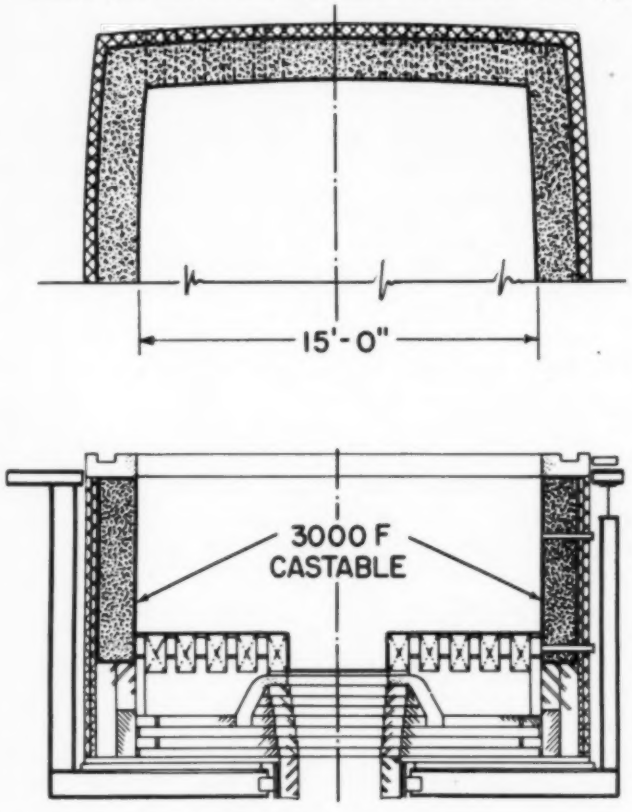


Figure 4 — Diagrammatic illustration shows castable refractory walls in soaking pit.

burning mixed coke oven and blast furnace gas. Chrome brick are installed at the cinder line and the castable extends from the top of the chrome brick to the top of the pit, with allowance being made for special curb tile on top of the walls.

The sidewalls consist of 18 in. of castable refractory plus block insulation. The endwalls are 22½ in. of castable for about 30 in. in height and the remaining height consists of 18 in. of castable plus block insulation. The pits are about 15 ft square. See Figure 4.

Two adjacent walls of the first pit were poured one day and the other two walls a day or so later.

The installation was made with a crew of 10 men at a ½ cu yd mixer and 3 men at the pit. Two thousand pounds of material were mixed at one time, and for a good part of the installation the castable was poured at the rate of 2000 lb every five minutes, or 24,000 lb per hr, equivalent to approximately 3200 brick per hour on a comparable volume basis. The total installation of four walls took approximately 7 hr actual working time, during which 50½ tons of refractory castable were placed. To this time should be added the necessary time for getting ready and cleaning up. In addition, there was a good deal of formwork, the unit cost of which could be reduced by the use of permanent collapsible forms.

The four walls of the second pit were placed in only four hours.

No provision was made for expansion, previous experience with this material on other types of installations indicating that expansion joints were not required. It was found on cooling the pits after the first heat-up that one crack appeared in the center of each wall. These cracks were ⅛ to ¼ in. in width in the cold condition and closed up when the pit was reheated.

The first of these complete pits was installed in May of this year, but was not placed in regular operation until after the steel strike ended. Reports are that after two months of operation no maintenance has been required, although it normally started within three to four weeks after a rebuilding with standard brick shapes.

3. *High thermal head furnaces* — Within recent years, the principle of rapid heating of billets and tubes by means of high thermal heads has gained increasing acceptance. The linings of such furnaces, usually circular in cross section, present a tedious job of cutting and fitting of brick, particularly around burner blocks. The use of castables eliminates this problem.

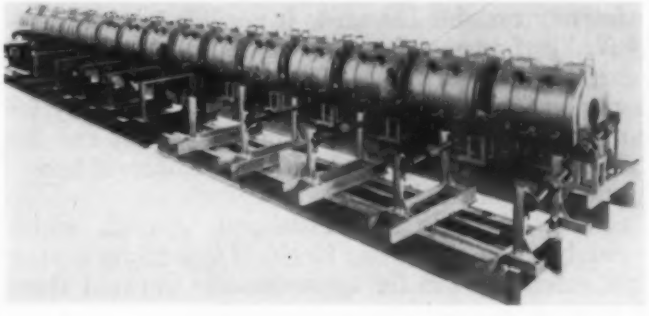
Figure 5 shows part of a line of barrel type furnaces to be installed in a steel mill in the southwest for the purpose of normalizing tubes up to 16 in. in diameter.

Initial furnaces of this general type originally installed about six years ago were lined with brick. The installation costs were high. As a result of several years' shop and field experimenting, it was decided to line the furnace with castable refractories. This was done only after the builder had assured himself that the material had superior refractory properties and would successfully handle the operating conditions without shrinking, spalling, or showing other adverse effects.

Pertinent data concerning the installation is listed below:

Number of barrel furnaces in one line . . .	33
Size of each furnace (approx)	
Length	6 ft-0 in.

Figure 5 — The line of high thermal head tube normalizing furnaces is lined with castable refractories.



Inside diam of furnace shell	5 ft-0 in.
Inside diam of lining	3 ft-3 in.
Lining thickness	
3000 F castable	6 in.
2200 F insulating castable	4 in.
Block insulation	½ in.
Fuel	Natural gas
Operating temperatures	2400 F

Based upon installed costs of previous furnaces lined with brick and evaluating the difference in sizes, also material and labor costs at present day prices, it is estimated that there is an advantage of 25 to 28 per cent reduction in installed cost by using refractory castables. This includes the extra cost of the required forms which were designed to be reusable.

4. *Cartop* — Perhaps one of the most annoying sources of maintenance to many operators are cartops of annealing and normalizing furnaces. The usual brick construction will oftentimes become a source of maintenance after the first heat up. The general pattern is that scale or other foreign material will get into the joints, and on alternate heatings and coolings, the sides and ends begin to push out, thus calling for continuous adjustment and repair.

Monolithic cartops eliminate in large measure the joints which are the source of principal weaknesses of a brick construction. Because of the ease of installation, castables are an ideal answer to a monolithic construction for such an application.

The cartop of a bloom annealing furnace in the Chicago area is 35 ft long by 10 ft wide. The usual heating charge consists of four blooms 14 in. square by 8 ft long spaced crosswise along the car to carry four lines of blooms, also 14 in. square totaling approximately 25 ft in length running lengthwise of the car. On top of these, a second course of crosswise blooms is placed and then a second set of longitudinal blooms. Considering the normal crane operation in placing matrial of these dimensions, it is not difficult to imagine the physical abuse to which these cars are subjected. Brick cartops gave the usual difficulties, maintenance normally commencing after the first heating and cooling cycle.

In November, 1951 one of the cartops was lined with 10 in. of castable refractory on top of 3 in. of an insulating concrete. Except for the duration of the strike, the furnace has been in steady operation since that time, operating on temperature cycles of 1700 F. As of September first, 1952 it had been unnecessary to perform any maintenance whatsoever on this car although brick lined cartops on adjacent furnaces have required maintenance after every cycle.

5. *Burner blocks* — Burner blocks are a problem in many plants, both because of maintenance and inventory. The introduction of a 3000 F volume stable refractory castable has made it possible to obtain improved performance from the blocks and has provided operators with a means of fabricating blocks on 24 hours' notice or less. This eliminates the necessity for anticipating requirements six months ahead and for tying up capital and space with large numbers of burner blocks of different sizes.

a. One plant in the Pittsburgh district, which formerly purchased burner blocks of a premium quality fired refractory has for approximately the past three years made all of their own blocks. The requirements cover billet heating furnaces, soaking pits, and heat treating furnaces of various types. It has been found that the life is equivalent to the high quality fired refractory blocks previously purchased. See Figure 6.

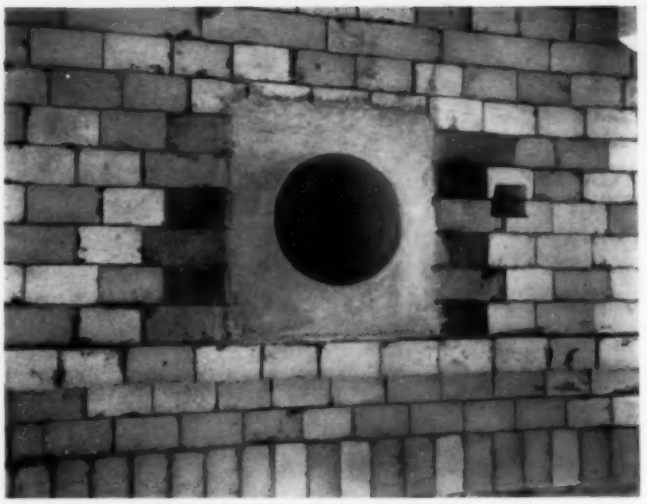


Figure 6 — Castable refractory burner block is used in rotary hearth billet heating furnace.

b. A prominent burner manufacturer uses the 3000 F kaolin base castable in a substantial number of burner blocks in conjunction with high thermal release burners. In this type of application, a volume-stable castable is required to withstand high temperatures and rapid temperature changes.

c. A furnace manufacturer who makes a large line of both gas and oil burners reports that in a high speed forge furnace their standard burner block was made from a super refractory material. Substitution of unfired burner blocks made with 3000 F castable refractory resulted in a block which had much higher thermal shock resistance and gave a service life up to 2½ times longer than previously obtained with the fired super refractory shapes. Figure 7 shows the application in question involving a high speed forging furnace operating at temperatures in excess of 2700 F.

6. *Billet and slab heating furnaces* — This type of furnace is often subject to high maintenance because of pressure to produce more than design capacity. As a result, higher fuel release rates are employed to obtain higher tonnage production rates, with the inevitable increased punishment on refractories. The use of a 3000 F volume-stable refractory for these furnaces offers both an improved refractory and a means for speeding up repairs.

a. An installation in the sidewall of a slab heater made in December 1951 is of significance because of its future implications on design.

The operators wished to obtain increased furnace width with the minimum sacrifice of thermal efficiency. It was decided to try castable refractory 7 in. thick backed up with 3 in. of high temperature block insulation to replace a wall consisting originally of 13½ in. firebrick plus 4½ in. insulating brick.

Anchor tile of a fired refractory having corrugated surfaces were located on 12 by 15-in. centers for a wall section approximately 6 ft in height by 10 ft in length. Next the block insulation was installed. Then forms were located 7 in. from the block insulation and were

placed in 15-in. high increments as the work progressed. The castable was mixed in a concrete mixer handling 200 lb of material in a batch. The total time required for placing the anchor tile and two tons of castable was 2½ hours.

Temperatures on the hot face of this furnace have been measured repeatedly in excess of 2800 F and at times to 3000 F. Reports after nine months' operation indicate that this installation shows no signs of shrinkage or deterioration.

b. The lintel over the discharge end of slab heating furnaces is normally a point of regular maintenance.

In the same plant covered in (a) above, the same castable was tried in the lintels. The lintels consist of a rectangular water cooled box tied to the structural steel and protected from direct exposure to furnace heat on the furnace side by T-slotted prefired brick shapes which fit over small I-beams welded to the water cooled box.

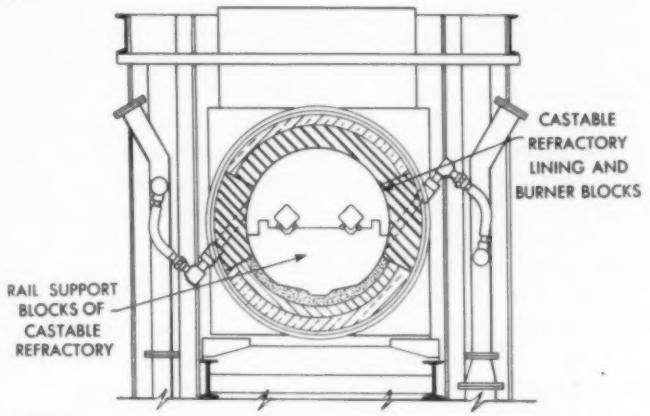


Figure 7 — Castable refractory burner blocks and lining in high speed forging furnace.

In November, 1951, the 3000 F castable refractory was used to replace the fired tile. It was installed 5½ in. thick around the I-beams and against the water box. In this particular repair, the installation of the castable was finished at 2:30 pm and the burners were lit at 8:00 pm, or only 5½ hours later.

When checked in early September of this year after nine months' service, the installation was reported to be in excellent condition.

c. In recent years methods have been devised to insulate cooling pipes in underfired steel mill heating furnaces. The same castable is used in precast reinforced pipe insulation for such furnaces. This system of insulating water-cooled skid pipes is reported to have resulted in important savings.

Miscellaneous — An effort has been made to cover the more significant fields of applications which have been opened up by improved castable refractories. In addition, there are such standard applications as:

a. Door linings for all types of furnaces.
b. Flat precast lintels over slot type openings.
c. Nose arches.
d. Locations normally requiring much cutting and fitting of fired brick, such as burner openings in walls, flue intersections, etc.

SUMMARY

From the applications covered in this paper it is reasonable to expect that the use of high temperature volume-stable castables will find increasing use in the steel mill. Possible fields, some of which are being investigated at the present are:

1. Fantails and nose arches of open hearths.
b. Roofs of slab and billet heating furnaces.
c. Ducts conducting high temperature gases and preheated air, including blast furnace ductwork.

The speed and economy of installation of refractory castables as compared with prefired refractories, and the availability of materials of the proper quality make inevitable their increased acceptance in steel mill applications.

DISCUSSION

PRESENTED BY

JAMES KNIVETON, Vice President, Selas Corp. of America, Philadelphia, Penna.

J. D. McCULLOUGH, Chief Engineer, Refractories Division, The Babcock & Wilcox Co., New York, N. Y.

JOHN J. HAZEL, Chief Ceramic Engineer, Republic Steel Corp., Cleveland, Ohio

B. L. DORSEY, Refractory Engineer, Jones & Laughlin Steel Corp., Pittsburgh, Penna.

G. L. ISAACS, General Foreman Blooming Mills, United States Steel Corp., Duquesne, Penna.

W. J. SCHARFENAKER, Masonry Superintendent, Ford Motor Co., Dearborn, Mich.

T. H. HARLEY, Refractories Engineer, Ford Motor Co., Dearborn, Mich.

James Kniveton: I think future papers, as further information and knowledge of castable materials is obtained, will probably contain considerably more data that might be of interest to those of us who are designing new furnaces. As one associated with a company who are designing, constructing, and placing in operation new equipment, we are always looking for information. In fact, I venture to say that all furnace engineers are hungry for information that can be obtained on such subjects as this. Information such as the thermal conductivity through composite walls would be helpful.

In our investigation and use of castable materials much of this wall data we have obtained ourselves in laboratory tests. We have to in order to be sure. Regardless of the initial cost of the material or the cost of installation, we have to be very sure that the materials and the thickness of the wall is suitable for the ultimate job.

The thermal conductivity is related to thickness and physical state change as the material is cured. In the paper reference is made actually to three distinct areas of a wall. The first zone is the high temperature zone, or one that has an exposed face where the material is vitrified for several inches resulting in a dense structure with high thermal conductivity.

The second zone, or what might be termed an intermediate temperature zone is one in which water of crystallization has been driven off, creating a system of pores producing a good insulating structure with lower thermal conductivity.

What I will term the third zone, the final few inches may be subject to less than 1000 F, in which area

crystallization has not taken place so this structure is void of pores resulting in a higher thermal conductivity than the second zone because of the denser mass.

Should thickness of the inner cast lining be carefully studied to eliminate this third zone? Is the answer a calculated thickness of inner lining castable with a backup of lower temperature material? I would say according to our investigation I believe the answer is yes. If Mr. McCullough can comment on this point I think it would be helpful to all.

J. D. McCullough: The question which has been posed is one which is under study by our laboratory at the present time. They are endeavoring to determine the zones of thermal conductivity with the various refractories in such a way it may be possible to anticipate just where a change will take place in a wall. Obviously, we are dealing with a material of the type in question that has different conductivities according to the temperature zone. It takes some time for this material to reach a steady state, that is, an equilibrium state in a furnace.

It is an advantage in many installations to have a backup installation. Certainly the over-all thermal conductivity of the castable would be improved by bringing the entire mass of the material up to the point where the water of crystallization will be driven off and where it would be possible to draw upon the maximum insulating effect of the castable.

I believe in any continuously operated furnace some backup installation, both to cut down the over-all heat loss and to improve the insulating value of the castable is desirable.

John J. Hazel: A brief look into history will show that the early development of castables was prompted by the U. S. Navy. This first castable carried the name of baffle mix, due to its early application for material in making baffle tile, as well as burner blocks and other uses around marine boilers. In this refractory, quick setting cement and ground brick were the major constituents. Many of the early applications failed due to improper mixing and often to unsuitable or low quality cement. Since then the great strides that have been made in the use of this type of refractory material have been accompanied by considerable improvement in the quality of the hydraulic cements used and the development of more refractory, especially made cements.

During the war years, and to a certain extent up to the present time, there has been a shortage of masons. As a result castable refractory materials have been time savers in many applications such as burner blocks, connections on hot blast mains and other applications in pipe work that otherwise would require many hours of expensive mason work.

For some time the connections in flues of the open hearths have been made from refractory castables. Time alone has been the essential factor in this application. We in Republic have used considerable tonnage of this type of material. For example, in the coke plants, gun blocks, doors and tops, etc, have been cast from this type of material. In the blast furnace we have cast domes; in the stoves we have cast the dome plugs. In the open hearths we have used it in connection with the flues, as previously mentioned, in the open hearth doors, and other lesser applications. In rolling mill heating furnaces we have cast burner blocks, sections of side walls, doors and piers. There are many applications of this type of material in the steel plants.

In all cases it is of the utmost importance that there be proper supervision of the preparing, mixing and application. Any failures can be traced back to improper mixing and installation. Proper drying out and firing are also important.

To sum up, it might be mentioned that castable refractories are special refractory materials. They are intended for special applications. Unquestionably they will give suitable service if, as previously mentioned, proper supervision is given to its preparation, mixing and installation.

Mr. McCullough mentioned the possible use of this material in the fan tails of our open hearths. Due to our high production rates and increased fuel input I would suggest that we go slow on this application.

B. L. Dorsey: The use of purchased castable refractories has been increasing rapidly in certain steel mill refractory structures. I use the word purchased to differentiate between the most recent flurry of applications and those that have been in use in some steel plants for many years. These are made by grinding suitable brick bats to proper sizes and mixing with a suitable hydraulic binder. In many cases, portland cement is used successfully as a binder but in others, a calcium aluminate (lumnite) cement is required.

Those uses which have persisted and proven economically practical over the years are: 1. Boiler baffles, 2. Bases of coil annealing furnaces, 3. Soaking pit sand seal troughs, 4. Blast furnace tuyere stocks, 5. Burner blocks, 6. Reheating furnace doors, 7. Certain pipe work, and 8. Boiler ash hoppers. Many other trial

TABLE I

Straight Wall Cost

	Base cost	Weight per cu ft	Cu ft wall per net ton	Refractory material cost per cu ft
3000 F Castable	$100.00/nt, fob	125	16	$ 6.25 add support cost tile and hanger range $1-$2/ set
9-in. brick				
Semi-silica and first quality	$ 94.60/m, fob	125	16	$ 1.62 add mortar cost* 8c-34c/cu ft
Super duty	$116.00/m, fob	140	14.3	$ 1.98 add mortar cost* 8c-34c/cu ft
Sillimanite	$595.00/m, fob	140	14.3	$10.07 add mortar cost* 8c-34c/cu ft
3000 F I.F.B.	$353.00/m, del	50	60	$ 5.83 add mortar cost* 8c-34c/cu ft
3000 F I.F.B.	$500.00/m, del	50	60	$ 8.03 add mortar cost* 8c-34c/cu ft

*Clay @ $20.00/nt to high temperature cement @ $100.00/nt. 400 lb/m equivalent.

TABLE II

Suspended Construction

Cost Per Sq Ft (Not Including 3-in. I's)

	7-in. Thick	9-in. Thick	
3000 F Castable	$4.90	$5.95	Including tile and hanger @ $1.26/set
Semi-silica and first quality	$3.99	$4.45	Including mortar @ $50.00/net ton
Super duty	$4.48	$5.05	Including mortar @ $50.00 net ton

applications have been made and for various reasons have not proven practical.

The greatest single factor which has added impetus to the use of purchased castables was the lack of experienced bricklayers during the heavy construction years after the war. In these times, the economic facts are more often by-passed for expediency and rightly so in some cases.

Tables I and II show refractory material cost on a comparable basis.

The in-place cost, labor and related crafts required, equipment available (not every plant has a concrete mixer, large or small) will vary over a wide range. A true cost will include all necessary related materials and crafts.

The elapsed time for an installation should begin when the forms are placed and end when the fuel is turned on. The making of repairs has been inadvertently omitted by Mr. McCullough. This is not surprising as experience to date is limited.

Refractory castables have a place, but not as a direct substitution for existing construction. One advantage not explored practically yet is that of sections that can be poured, at convenience, and moved by heavy equipment cranes, etc, into a furnace roof or wall in a minimum of time. Monolithic sections would be far superior to brick units for this approach to rapid safe furnace repairs.

J. D. McCullough: As far as the comments on the relative cost of castables of various types of brick are concerned, as brought out by Mr. Dorsey, every material has to stand on its own merits from an over-all economic standpoint. Some of the factors of first cost were brought out by Mr. Dorsey. Whether that properly represents comparative installed costs is questionable. Before the evaluation can be considered completely, it is necessary to take into account 1. the total service life and whatever maintenance may be involved in the service life plus 2. the greater availability of equipment which can be obtained by the use of castables, thereby reducing the down time. When some furnaces go down, your mill production stops. You may be charged at the rate of hundreds of dollars, or thousands of dollars an hour. The first cost of the material that is going in may be very minor as compared with the lost production.

G. L. Isaacs: Duquesne has been trying castables since 1942, and I have to admit they did not meet with much success until 1949. Since that time, we have gone a long way. In fact, we have replaced all of our brick soaking pit covers with castable covers and our cost has been cut by 300 per cent.

We are in the unfortunate position of having a condition that results in the burning of cover side frames and the loss of the side brick, giving in turn the loss of the whole cover. However, with the castable material, only part of the side frame is lost, and it can be knocked out and repatched at practically no material cost.

Now, we have gone further than that. We have cast an entire row of regenerative soaking pits. The cast pits cost exactly twice as much as brick pits and another bad feature of castable pits is that it is very hard to patch.

In addition to soaking pit repairs, we are experimenting with cast walls on continuous furnaces. A burner port wall was cast in June 1951. That wall is still in service and there are no signs of cracking or spalling, or damage of any kind.

Another place we have used castable refractories is in a batch-type furnace. It is an in-and-out type furnace. We have recently cast a complete front wall including the door jambs, and this method has decreased the maintenance by at least 50 per cent. It is the monolithic construction that does the job there, not particularly the refractoriness.

In heat treating furnaces, we are using lower temperature castables that are doing a good job.

One application that has not been stressed too much here is the miscellaneous uses of this refractory castable. It does a wonderful job when you are in a hurry. If you lose part of a soaking pit cover, it is very easy to patch that cover in four or five hours. It is not recommended by the manufacturer of the castable because of the heat but it does a fair job. Reheating furnace doors, that are subjected to banging and slamming last much longer if lined by casting.

Now, I have a few questions for Mr. McCullough. The first one is on water content. We have found that manufacturers are giving us recommendations that come from the laboratory, and generally they are determined by mixes of about a cu ft of the material. When we are mixing up six to twelve bag batches, we have found that we do not get a complete hydraulic set in the material. By increasing the water two or three per cent over the manufacturer's recommendations, we are getting a better "green" strength. What would be the loss of fired strength?

The second question is on laying up this refractory cement with a gun. I have noticed that a large number of the heavier particles are rebounding. What is the adverse effect of losing those larger particles?

I am also curious to know what the difference would be between a flint clay base, and a kaolin base castable.

J. D. McCullough: So far as water content is concerned, it is quite possible that manufacturers may recommend the amount based upon conditions of perfect placement involving considerably more work and attention to rodding, tamping, etc, than can be obtained on many jobs. If a more thorough job of placement can

be accomplished in the field by adding 1 to 2 per cent additional water to make the material more workable, I do not believe the manufacturer would object.

As regards the loss of particles in running some preliminary tests which we have run indicate that the elimination of the very coarsest particles from our 3000 F castable has only a relatively small effect upon the refractory characteristics or use limit of the material itself.

As regards the last question raised by Mr. Isaacs on the difference between castables having a flint clay base and a kaolin base, there are other things that must be taken into account; first is the type of binder, second, is the alumina content, and third, is the type and amount of impurities. All of these points have a bearing on service performance.

W. J. Scharfenaker: We have confined the paper primarily to refractory castables. Before we learn how to use the standard materials, here we have another new one to figure out. Everyone has not figured out how to use the old ones yet.

I would like to ask Mr. McCullough a question. We at Ford have used castables in numerous applications, some of which, I imagine, would surprise Mr. McCullough. There is a job going on in our plant right at this moment in a spot where I have some misgivings an an intermediate temperature range.

What could you tell me about the application of castable materials in locations of intermediate temperature range, something in the neighborhood of 1000 to 1500 F.

I understand there is a weak zone; is that correct?

J. D. McCullough: Yes, there is a weak zone which occurs between generally 1000 and 2000 F, in that you do not have there the same strength that you will have under the cold conditions, but you still have a strength which consists of hundreds of pounds per square inch.

W. J. Scharfenaker: I will be more specific. The job I have in mind is the brick curbing around the base of a box-type annealing furnace with no load on it, and heat shock is the primary thing that gets it over a period of time. Originally built with brick, we are putting in a section with castable. What do you think?

J. D. McCullough: I would like to know more about the details, but perhaps I can give you an answer here. Radiant tube covers normally operate at temperatures from 1500 to 1600 F which from the standpoint of loss of strength of castable is about the weakest range.

We have many instances of castable bases for radiant tube covers that have for years been subjected to the placing and withdrawal of heavy loads, heating and cooling, and they are doing a very fine job.

W. J. Scharfenaker: What is down-time for hot patching with castables if forms must be installed against using brick for repairing soaking pit walls — a section large enough that you have to install forms. What is the comparison on down-time on repair jobs?

J. D. McCullough: In certain cases your castables will not show up to advantage on such a job. If you have a really hot wall and you are trying to bring it down in a question of just hours and get back into operation, I would question whether a castable is the proper material to use.

(Author's note: Since the foregoing discussion took place at least one plant has been successful in installing a form in a hot pit and filling the space between the form and the pit wall with a castable. The pits have been out of operation only a matter of several hours and have not been cooled down.)

T. Harley: I would like to ask Mr. McCullough a question regarding the installation of a sprung arch soaking pit cover, where you do not use hanger tile. Would you recommend, or is it necessary, or is it permissible to use steel reinforcing bars, or do you frown on such additional reinforcement?

J. D. McCullough: We usually recommend against embedding any steel within the castable and I think the reason is relatively easy to understand. Your coefficient of expansion of the refractory and the steel is not the same. Your steel may have a coefficient of expansion from two to three times that of the refractory, so if you imbed your steel in the refractory and it starts getting very hot, then it is going to expand and it is going to cause a rupture of the castable itself.

Now our experience generally has been that if instead of trying to do something like that, you imbed anchors, maybe anchors on 12 to 18-in. centers that will extend into the castable a certain distance, and then tie back to the supporting steel, those individual anchors will do some good.

T. Harley: Are those refractory anchors you are referring to?

J. D. McCullough: Both metallic and refractory and, if they are metallic, it is necessary to use a proper grade of alloy for the temperature to which they will be exposed.

T. Harley: On these large soaking pit walls you described, is it necessary to cool them by wet applications over the top of the surface while they are cured?

J. D. McCullough: In that particular case the forms were not removed for 24 hours and wet bags were placed over the upper part for about that period of time, and that was sufficient. That will vary with different types of castables according to the binder.

Member: I would like to ask Mr. McCullough, several questions concerning electric furnace applications. In the use of electric melting furnaces, have you used or approached any castable patching applications?

J. D. McCullough: We have cast some complete roofs of electric furnaces and came to the conclusion that it was not economically justified. Based upon the types of castables that are available at the present time, we have not been advocating patching of electric furnace roofs. If any patching is to be done, our present feeling is that it can better be performed by a higher temperature ramming mix.

Member: Have you done any fortification of roofs with castable in brick lined roofs?

J. D. McCullough: We have put in some installations of electric furnace roofs in which we would have brick up to the electrodes and then castables in the electrode section, if that is what you mean.

Member: Would you recommend that on 20-ft furnaces?

J. D. McCullough: No. Now it may be that something can be done there with ramming mixes, but based upon our experience with castables, we would not.

It is not the fact that the castable will fail, necessarily — it is the fact that the majority of castables at the present time do not have the temperature use

limit which will give them an economic life in that opening around the electrodes, which is the zone of worst punishment. That is where you should use your most refractory material rather than your less refractory.

Member: One other question. In your application of castable material, through what type of gun do you apply that?

J. D. McCullough: I would imagine that it could be done with any of the conventional guns. Our experience so far has been chiefly with the Allentown cement gun, but there are several guns operating on the same principle of the dry material going through the hose with the water being added at the nozzle.

W. J. Scharfenaker: Only a few weeks ago I talked to a man out in one of the eastern plants who is plagued with a serious shortage of bricklayers. He has done considerable with plastics, castables, etc. At the time I talked to him, he was quite happy. Only the week before, after much pushing and pulling through their labor contract, he had received a ruling from their arbitrator. They now are able to place castables and plastics with a special kind of laborer, refractory laborers.

A word of caution. We at Ford have had some experience with castables, some with plastics and other things. It is not a cure-all. There are places where it will do some good. It requires some thought. It requires a little work with a sharp pencil. Most castable materials, if you figure them back on a price per cubic foot basis, are not cheap.

There are places where they will do a job. Those places will be more numerous in plants which are plagued with a bricklayer shortage, and they will be greater in plants which are able to install the materials with laborers rather than having bricklayers on the job.

I will take a moment to review some of the spots where we have successfully applied castable materials in our steel plant.

We have a new battery of coke ovens that just went into production a few weeks ago. The flue system is poured refractory concrete. I will start from that end of the plant and go through. We have had no appreciable application in the blast furnace plant. Those people who are familiar with the brick work in the intersections of blast furnace piping, where two sections of pipe come together, know the brick work in the intersection arch is complicated. There have been successful applications of castables in those locations. However, we have not done it, but there have been.

We today put in a small section of castable in a dust catcher.

The open hearth has numerous applications. We have one of our open hearth furnaces shortly scheduled for a big remodeling job. The flue system from the reversing dampers to the stack will be poured. These are big flues, flues big enough that three of us could walk abreast through. They will be poured.

A number of installations have been made in new checker settings in the last couple of years. While the checkers were out, we put new soot blowers in the tunnels underneath the checkers. We dug out the old pipes where there were old pipes. A couple of furnaces never did have soot blowers. We laid prefabricated pipes in. Rather than take the time for cutting and all the spoiled brick, with a bricklayer down in the hole chopping and fitting around the pipes, we used castable to protect the pipes for the soot blower system successfully. It has proved to be a good installation.

In all of our open hearth furnaces, we do not have them all in, but most of them have been built, we have installed clean-out holes, or access holes, to the reversing damper seats. We use a buster and punch through the floor and down through the arch. We make a hole, put in a steel box with studs around, form and pour.

I was listening very carefully to Mr. McCullough's advice on how to properly place and cure refractory concrete. There have been times when we have been caught at the tail end of a job when we had the hearth fire on already when we poured. We did not have time to strip the forms, and left them in to burn out. They did not fail and it worked.

Open hearth furnace fantails, even part of the way back on checker roofs are spots that are troublesome particularly, due to dirt coming down from up on the floor. You get dirt working into the joints of the brickwork, and infiltration and water. We have over a period of time been putting castable over the top of brickwork in our fantail sections successfully. It not only cuts down on infiltration, but prevents dirt from above getting into joints, and prevents water from getting to the brickwork; a successful application.

We have a limited number of successful soaking pit covers that have been poured. Again, as a matter of economics on big, wide soaking pit covers where it becomes necessary to use a flat arch, a castable is something that is certainly in the picture. In my mind it is still questionable on a narrow span cover, where you can use a sprung arch without too much trouble.

We have poured some soaking pit floors successfully.

Back to the open hearth, the open hearth furnace fantail, hole in fantail, hole right under a beam, frame of the furnace is a most difficult spot, almost impossible for a bricklayer to get at and patch it. We did not even take the fire off the furnace, but hung a sheet iron in the hole and poured some castable in, and it worked with no curing at all.

On continuous slab heating furnaces, again we have been caught with a hole in the roof, flat, not sprung, but flat suspended roof with elaborate special shapes and hangers, and castings, etc. We have put in sections as big as six feet square with fire off the furnace for four hours, and it worked.

We have a continuous bar heating furnace. One section of the roof included brick which are three ft long, 12 in. high and 4½ in. thick, weighed about 85 pounds. It took a husky man or two or three small ones to put one of them in place. Recently we replaced that section, and did not use those big heavy blocks. You cannot get good brick that big anyhow. They did not last too long. We replaced them with castable successfully.

There are many applications where it can be used and used successfully and to advantage. But again, a word of caution. Do not lay your sharp pencil aside. Look at the cost of the material. It has its place, but you have to watch the cost per cubic foot, too.

One other thing, a problem which the steel industry has. There are many, many square miles of mill floors that have need for a good, cheap, refractory castable which has good wearing properties and will take a bit of heat shock. I have not seen such a material yet but I would like to.

AISE SPRING CONFERENCE....PICTORIAL REVIEW

BUFFALO, N. Y.

MAY 18, 19, 1953

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The 1953 annual Spring Conference sponsored by the Rolling Mill Committee, of the Association of Iron and Steel Engineers, held May 18 and 19 at the Hotel Statler, Buffalo, N. Y., was attended by 625 members and guests.

At a meeting of the Board of Directors of the Association (1) on May 17, J. L. Young, president, J. H. Vohr, second vice president, W. H. Collison, treasurer, and J. D. O'Roark, secretary comment on the program. Registration (2) on the mezzanine of the Statler provided a meeting-place for the visiting members. George Kaufman, Jones & Laughlin Steel Corp. (3), P. B. Mansfield, Republic Steel Corp., W. J. Tunny, Youngstown Sheet and Tube Co., A. W. Smith, Westinghouse Electric Corp., and R. E. Marrs, General Electric Co. discuss papers to be presented at the Electrical Session. The Rolling Mill Session (4) opened the Conference, featuring papers by (5) J. H. Hitchcock, and E. S. Murrah, Morgan Construction Co., and (far right) R. L. Deily, Air Reduction Co., Alex Montgomery, Jr., U. S. Steel Corp. and G. A. Henderson, Bethlehem Steel Co. were co-chairmen. At the second Rolling Mill Session (6) co-chairmen J. N. Imel, Jones and Laughlin Steel Corp. and Louis Moses, Bethlehem Steel Co. (standing) check an item in the paper of Howard H. Morgan, Jones and Laughlin Steel Corp., with G. S. Mican, U. S. Steel Corp., and J. H. Mayer, Jones and Laughlin Steel Corp. looking on. Members of the Technical Session (7) N. M. Pusateri and A. L. Lancaster, Amsler Morton Corp., E. T. W. Bailey, Steel Co. of Canada, Ltd. (seated) J. R. Lottes, American Brake Shoe Co., A. F. Kritscher, U. S. Steel Corp., and F. R. Pullen, Bethlehem Steel Corp. (standing) get together for a last-minute conference.

Shown in (8) are M. T. Satter, Continental Foundry and Machine Co., C. W. Barrett, Republic Steel Corp., R. A. Hawkinson, Republic Steel Corp., W. C. Berg, Continental Foundry and Machine Co., and Frank Zipf, Bethlehem Steel Corp. A story by W. E. Zelley, John A. Roebling's Sons Corp. (9) entertains Charles Burden, John A. Roebling's Sons Corp. and Russ Plummer, Aluminum Co. of America. G. A. Henderson, (10) Bethlehem Steel Co., Alex Montgomery, Jr., U. S. Steel Corp. and A. M. Cameron, Atlas Steels, Ltd., chat with E. T. Peterson, Birdsboro Steel Foundry and Machine Co., while in (11) F. I. Roberts, Canadian Tube and Steel Corp., Dawson Wade, Granite City Steel Co., Sydney Williams, Mesta Machine Co. and C. L. Hieber of Canadian Tube and Steel Corp. have a session of their own.

A window of the Hotel Statler (12) serves as a backdrop for E. G. Benson and R. G. Orthwein, of the A. J. Boynton Co. and M. E. Knudsen, Westinghouse Electric Corp. Caught in a festive mood (13) are W. H. Boyle, Kaiser Steel Corp., R. C. Massey, Aetna-Standard Engineering Co., R. C. MacDonald, Kaiser Steel Corp. and (standing) W. J. McMillen, Mackintosh-Hemphill Co. A round table discussion (14) includes T. M. Fairchild, Bethlehem Steel Co., W. H. Bennett, Bethlehem Steel Co., R. D. Hughes, and Herb Frey, Pittsburgh Rolls Division, Blaw-Knox Co., and W. H. Mohler, U. S. Steel Corp. Following the Technical Session (15) George Perrault and L. P. Anderson, E. W. Bliss Co., get together with Milo Shott and C. R. McNally, Alliance Machine Co., and R. M. Lutz, James Garland, and C. R. Schmitt, Crucible Steel Corp.

Preceding the banquet, held May 18, a reception was held for guests to be seated at the speaker's table. Among those attending were: W. R. Breeler, Allegheny Ludlum Steel Corp., E. F. Martin, Republic Steel Corp. and H. L. Allen, Republic Steel Corp. (16); and J. H. Vohr, U. S. Steel Corp., C. F. Anderson, Page-Hersey Tubes, Ltd., and I. N. Tull, Republic Steel Corp. (17). Guest speaker at the banquet (18) Stuart Armour, economic adviser to the president, Steel Co. of Canada, Ltd., is greeted by J. L. Young, AISE president. M. A. Leishman, Steel Co. of Canada, Ltd., looks on.

On May 19 guests boarded buses (19) for a full day's inspection trip to the Hamilton, Ontario, works of Steel Co. of Canada, Ltd., the climax of another eventful Spring Conference.

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Lubricants For

By ALLEN A. BROWN
Reilly-Whiteman-Walton Co.
Conshohocken, Penna.

▲ AS with most things in our experience, it is of prime importance, when considering drawing lubricants, to get down to fundamentals. The fundamentals are well known but, unfortunately, often lost sight of, when we are confronted with a drawing lubricant problem. Hence, with the full realization that we will be repeating things that have been well covered in the past, and available in the literature, let us first discuss drawing operations in general. Then, we propose to cover some of the fundamental requirements of lubricants for drawing metals. And, finally, we will give particular emphasis to the extremely important role played by the fatty oils and their derivatives, as drawing lubricants, or as components of such lubricants.

Number one fundamental to keep in mind, in this discussion, is the nature of the thing with which we are working. Practically all metals are crystalline in nature, and their surfaces are not perfectly smooth. Even the finest finishing operations will leave jagged edges, fragmented crystals, hills and valleys. These surfaces are not chemically clean, and they have coatings of oxides, water vapor, and chemical compounds resulting from pickling, cleaning, or other processing operations. Number one, then, is that we are not dealing with a clean smooth surface; it is contaminated, and it is rough.

The second important thing is to remember that unit pressures are high. They have to be, as the forces *must* be such as to exceed the yield strength of the metal, whenever we are actually *drawing* metal, by means of forcing or pulling it through a die. These forces are exerted over a much, much smaller area than casual observation might indicate. Even with very heavily loaded surfaces, with all the surface irregularities, hills, and valleys flattened, probably the entire load is carried by no more than two or three per cent of the apparent area. The forces have to be high, the unit pressures high, very high—that is the second thing to keep in mind.

These forces, applied to the work piece in drawing, result in motion within the metal being formed, and in the sliding of the work piece surface across the die. It is no longer believed that the friction, resulting from the sliding motion of the metal being drawn through the die, is the result of the interlocking of the hills and valleys of the metal surfaces in sliding contact; rather, it is felt that this friction is the result of intermolecular attraction between portions of the two surfaces, in close proximity. These forces are very large, and result in *welding* of limited areas of the two surfaces. The *third* thing to keep in mind, then, is that welding of the high spots is occurring, and it is the forces involved in making and breaking these welds that account for the large portion of surface frictional resistance in drawing operations.

As these welds are made and broken, "sticking" and "slipping" occurs, but so rapidly, in most cases, that it cannot be observed. Even with "well lubricated" drawing operations, this welding probably occurs to a greater extent than is realized; if lubrication fails, the tiny welds increase in size until they are large enough to be seen by the naked eye. We then say that "scratching" has occurred.

The prime purpose of a drawing lubricant, therefore, is simply to prevent this welding of the surface high points during sliding contact. There are many other auxiliary requirements, for a good drawing lubricant, but this is its basic purpose. Once this purpose is accomplished, it is then possible to turn to the matter of the internal friction of the lubricant itself.

The frictional resistance, which can be affected by a choice of drawing lubricants, is that due to welding and also that due to the resistance to stress deformation of the lubricant itself. If we include, in this discussion of drawing lubricants, the wide variety of metallic coatings, fillers, pigments, reactive materials, as well as the unctuous substances (which usually come to mind when we think of a "lubricant"), it will be realized that the internal friction of the lubricant can be excessive. However, the cold working of metals of high yield strength usually requires a degree of weld prevention which cannot be obtained from unctuous lubricants alone.

Nor is it always desirable to reduce the surface friction to a minimum, in a drawing operation. The improper flow of metal, as in a deep drawing operation where wrinkling occurs, can often be corrected by using a drawing compound having a higher internal friction.

It may be easier to think of the basic weld prevention function, as that of separation, and of the internal lubricant friction as the degree of slip. Metallic coatings, fillers, pigments, and the like, provide a lot of separation and very little slip. Fluid oils, on the other hand, do not have comparable separating ability, but do have very low internal friction. In most drawing compounds, an attempt is made to combine adequate separating ability with an optimum amount of slip for the particular application. This does not mean, necessarily, that it is always possible to combine these properties in a single compound; it may be better to apply the separating phase as a coating, firmly bonded to the work piece, and follow this with the application of the slip producing phase.

The terms "fluid film lubrication" and "boundary lubrication" are often used in describing lubricants, and it might be well to differentiate between these before proceeding further. In most bearing lubrication, the unit pressures are relatively low, and non-polar, non-reactive lubricants, such as mineral oils, will maintain a relatively thick lubricant film. The pressures are not high enough to squeeze the metal surface together, and no welding takes place. Very low frictional coefficients (in the order of 0.005) are observed. If proper attention

Drawing Metals

. . . . through studies of the fundamental behavior of lubricant molecules, improvements are derived for both drawing and lubricating applications . . . .

is paid to bearing design, clearances, oil application, and the like, wear of the bearings is virtually absent. Fluid film lubrication conditions do not prevail in cold working operations, and fluid film lubricants have little or no value as metal working lubricants.

Boundary lubrication is the term that is used to describe the conditions which exist when it is not possible to obtain fluid film lubrication; that is, when unit pressures are high, as in a drawing operation. Frictional coefficients are high (0.02–0.10) and the hydrodynamic laws used for fluid lubricants no longer apply. Lubricants of a far different type than those used in fluid lubrication must be considered.

Since weld prevention, or the separation of the work piece from the tool is the basic requirement, we should first consider the various means now used to accomplish this end. Coatings of ductile metals, such as lead, copper, tin, and zinc, probably provide the maximum in separating ability; unfortunately, they also entail the greatest expense and handling difficulties. The growing use of phosphate coatings (primarily zinc phosphate) may be attributed to the somewhat greater ease of application combined with excellent separating ability. Sulphide and oxalate coatings are employed on metals which will not "take" a phosphate coating. Borax, lime, and rust (sull coating) are in everyday use, as is well known. With all of these coatings, it is necessary to use a separately applied slip producing phase, and the surface friction is relatively high because of the necessity of deforming the coating.

When no coating is applied intentionally, there still exists on the work piece surface a film of oxide and water vapor. Without this film, the forming of "bare" metal, by use of conventional drawing lubricants, would be a far different problem, and it is unfortunate that more attention has not been paid to this aspect of the problem. When a drawing lubricant is applied to such a "bare" metal surface, without a separately applied coating, weld prevention is accomplished by both the surface contaminants and the drawing compound itself. There are many, many applications where a separately applied coating is the best answer to a difficult lubrication problem; at the same time, there are applications where the expense of a separately applied coating could be saved if more attention would be paid to surface preparation of the work to be processed.

Drawing lubricants which are used as the slip producing phase over coatings do not differ greatly from those which are directly applied to "bare" metal. When no coating is present, it is often necessary to build increased separation into the drawing compound, by the use of pigments or reactive elements; except for noting this, no further distinction will be made.

The vast number of drawing compounds available to industry, in addition to a large number of mixtures made by operating personnel, indicates that there are considerations other than those already mentioned. Indeed, these secondary requirements usually dictate the choice of a particular lubricant for the application. Weld prevention and lubricant friction having been established to the point of obtaining scratch free work, with satisfactory tool life and a minimum number of passes (when multiple drafting is required), the major secondary considerations are: application, stability, corrosion, removal, economy, and both physiological and psychological effect on personnel.

The method of application is often dictated by the type of work. For instance, it is not practical to swab a drawing compound on the inside surface of a tube, and application must be by immersion, or by circulation at the draw bench. In the case of forming an automobile fender, the compound is "spotted" in order to secure satisfactory flow of the metal. Compounds which will work with one method of application may fail if applied by another. In general, the longer the time interval between application of the compound and the drawing operation, the better will be the results obtained. When the compound is expected to give maximum separation, and is applied from an emulsion or water dispersion, forced drying of the water from the compound may make the difference between success and failure. Concentration of water dispersible compounds is very important, and it is not unusual to find that leaner dispersions will work better than more costly, richer mixes.

Stability of the compound usually is a problem only with those products intended for use as emulsions. The emulsion may be too unstable for a particular operation; or it may be too stable. If it is unstable, very uneven application results, with large quantities of lubricant being applied to certain areas or certain pieces, coupled with little or no lubricant or other areas or pieces. Lubricants which are too stable, where the lubricant is hard to take out of the water used the diluent, usually provide insufficient lubrication. With a given compound, the stability is affected by water hardness, temperature of application, aging of the emulsion, and contamination—usually from acid residues of prior operations. Lubricants which contain fillers or pigments must be agitated constantly in order to prevent sedimentation of the pigment, unless they are used so concentrated as to prevent sedimentation of the pigment by high viscosity of the compound.

Corrosion of work, or equipment, can be caused by improper selection of drawing compounds. This can be extremely severe with some compounds if annealing is done without prior cleaning. Reactive elements, such as sulphur and chlorine, on one form or another, are excellent weld preventives, and are used in a great many compounds intended for difficult work. Highly alkaline products may be just the thing for some jobs, but not for a galvanized surface.

The removal of a metal working lubricant can cause all kinds of trouble, or it may be accomplished with ease. The very products and procedures which may give the best separation of the work piece from the tool are the ones which may offer the greatest resistance to cleaning. Compounds containing fillers and pigments are bad offenders, as these are pressed into the metal; in some cases they can be removed only by abrasion.

True economy involves a great many considerations other than the price per pound of a given product. While high cost of a lubricant is no guarantee of an optimum balance of desired characteristics for an operation, it is obvious, likewise, that the lubricant pennies can be held so close to the eye as to prevent seeing the production dollars.

job on the part of the compound manufacturer. There is very little standardization of metal processing lubricants, as it usually is the lubricant which is tailored for an application, rather than the reverse. It is obvious that much can be gained, under these circumstances, by a most thorough, on the spot study of requirements by adequately trained representatives of lubricant suppliers.

Attempts have been made to segregate drawing lubricants into various categories; pigmented (those which contain solid fillers, such as mica, chalk, clay, graphite, talc, and the like) and non-pigmented; reactive (such as sulphur or chlorine containing materials) and non-reactive; oil-soluble and water soluble; soaps and waxes —and so on. Other classifications have to do with appli-

Composition

FATTY ACID DATA	CAPROIC	CAPRYLIC	CAPRIC	LAURIC	MYRISTIC	PALMITIC	STEARIC	ARACHIDIC	BEHENIC	LIGNOCERIC	LAUROLEIC	MYRISTOLEIC	PALMITOLEIC	OLEIC	RICINOLEIC	ERUCIC	LINOLEIC	LINOLENIC	ELAEOSTEARIC	LICANIC	MIXED ACIDS	MIXED ACIDS	MIXED ACIDS	MIXED ACIDS	MIXED ACIDS
CARBON ATOMS	6	8	10	12	14	16	18	20	22	24	12	14	16	18	18	22	18	18	18	18	18	18	20	22	24
DOUBLE BONDS	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	3	3	3	3	3-6	5-9	2-9	1
HYDROXYL GROUPS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MOLECULAR WEIGHT	116	144	172	200	228	256	284	313	341	369	198	226	254	282	298	339	280	278	278	292					
ACID NUMBER	483	389	326	280	246	219	198	179	165	152	285	248	221	199	188	166	200	201	201	192					
MELTING POINT (°C.)	-1	16	31	44	54	63	70	75	80	84	liq	liq	-2	14	5	34	liq	liq	49	74					
VEGETABLE OILS & FATS																									
BABASSU KERNEL	tr	6	3	46	20	7								18											
CASTOR						1								tr	92		7								
CHINESE VEG.TALLOW				2	4	66	1							27											
COCONUT	tr	8	8	45	18	10	2							8			1								
CORN						8	3	1						46			42								
COTTONSEED					2	21	1	1						30			45								
HEMPSEED						6	2	1						6			69	16							
LINSEED					tr	5	4	1						10			42	38							
MUSTARD SEED						2				2				24		50	20	2							
OITICICA						11								6			10			73					
OLIVE					1	10	1	1						80			7								
PALM					3	43	3							41			10								
PALM KERNEL		3	7	47	14	9	1							18			1								
PEANUT						8	3	2	3	1				57			26	44							
PERILLA						6	2							4			44								
POPPY SEED						5	3							30			62								
RAPE SEED						1	1		1	1				30		50	15	1							
RICE BRAN					tr	13	2	1		1				44			39								
SAFFLOWER SEED						4	2	tr						26			68	tr							
SESAME						9	4	1						45			41								
SOYBEAN					tr	10	2	1						29			51	7							
SUNFLOWER SEED						5	3	1						34			59								
TEA SEED					tr	8	1							83			8								
TUNG (CHINA WOOD)						3	1							4			1		91						
ANIMAL OILS & FATS																									
BUTTER FAT	2	1	2	3	7	22	12	1						42			5								
LARD					1	30	18						2	41			8								
LARD OIL(35 DEGREE)					1	21	8						3	58			9								
NEATSFOOT(20 DEGREE)						18	3							79											
TALLOW(BEEF)					2	32	15							48			3								
TALLOW(MUTTON)					1	21	30							43			5								
MARINE OILS																									
COD-LIVER						3	10					1	15									25	32	14	
HERRING						8	12	1				1	6									21	28	23	
MENHADEN						6	16	2					15									30	19	12	
SALMON						4	15	2					10									29	24	16	
SARDINE						6	10	2					13									24	26	19	
SHARK-LIVER						1	13	3					3									35	17	16	12
WHALE						6	18	2					13												
SPERM(BODY)				1	5	7							26									39	12	6	
SPERM(HEAD)			3	16	14	8	2					4	15									57	19	1	
																						17	7		

Characteristics	SAPONIFICATION VALUE	IODINE VALUE	SOLIDIFICATION POINT (°C.)	TITER (°C.)	UNSAPONIFIABLE (%)
BABASSU KERNEL	247 / 251	14 / 18	22 / 23	22 / 23	0.1 / 0.8
CASTOR	176 / 187	81 / 91	-10 /-18	2 / 4	0.3 / 1.0
CHINESE VEG.TALLOW	200 / 209	20 / 29	25 / 35	45 / 53	0.5 / 1.5
COCONUT	250 / 264	7 / 11	19 / 23	20 / 24	0.2 / 0.5
CORN	187 / 193	103 / 128	-10 /-15	14 / 20	1.5 / 2.5
COTTONSEED	189 / 198	99 / 113	3 / 4	30 / 37	0.6 / 1.6
HEMPSEED	190 / 195	150 / 166	-15 /-27	14 / 17	1.0 / 1.5
LINSEED	190 / 198	170 / 204	-16 /-27	19 / 21	0.5 / 1.7
MUSTARD SEED	173 / 184	106 / 124	-11 /-18	6 / 10	0.9 / 1.5
OITICICA	186 / 193	140 / 160		42 / 47	0.4 / 1.0
OLIVE	188 / 196	80 / 88	-6 / 10	17 / 26	0.5 / 1.8
PALM	195 / 205	44 / 58	31 / 39	40 / 47	0.2 / 1.0
PALM KERNEL	245 / 255	14 / 23	19 / 24	20 / 28	0.2 / 1.0
PEANUT	188 / 195	84 / 100	0 / 3	26 / 32	0.2 / 1.0
PERILLA	188 / 197	193 / 208		12 / 17	0.4 / 1.5
POPPY SEED	189 / 196	130 / 140	-15 /-20	15 / 19	0.5 / 0.7
RAPE SEED	170 / 180	97 / 108	-10 / 10	11 / 15	0.5 / 1.5
RICE BRAN	183 / 194	92 / 109	- 5 /-10	26 / 28	3.0 / 5.0
SAFFLOWER SEED	188 / 194	140 / 150	-13 /-20	15 / 18	0.5 / 1.5
SESAME	188 / 195	103 / 116	0 /-6	20 / 25	0.7 / 1.5
SOYBEAN	189 / 195	120 / 141	- 8 /-18	20 / 24	0.2 / 1.5
SUNFLOWER SEED	188 / 194	125 / 136	-16 /-19	16 / 20	0.3 / 1.5
TEA SEED	188 / 196	80 / 90	-5 /-12	13 / 18	0.2 / 1.5
TUNG (CHINA WOOD)	189 / 195	140 / 152	2 / 3	31 / 38	0.4 / 1.1
BUTTER FAT	210 / 233	26 / 42	19 / 24	33 / 38	0.3 / 0.5
LARD	190 / 202	50 / 70	22 / 32	32 / 42	0.2 / 0.8
LARD OIL(35 DEGREE)	192 / 200	61 / 79	-3 / 2	27 / 34	0.2 / 0.8
NEATSFOOT(20 DEGREE)	190 / 199	70 / 78	-6 /-9	22 / 26	0.1 / 0.7
TALLOW(BEEF)	190 / 199	40 / 48	30 / 38	40 / 47	0.2 / 0.7
TALLOW(MUTTON)	192 / 197	35 / 46	32 / 45	43 / 48	0.2 / 0.7
COD-LIVER	180 / 190	140 / 170	0 /-10	18 / 24	0.5 / 1.7
HERRING	179 / 194	123 / 146	-3 / 3	23 / 30	2.0 / 3.0
MENHADEN	189 / 193	154 / 180	-6 / 3	31 / 33	0.6 / 1.6
SALMON	183 / 188	141 / 166	-4 /-10	20 / 25	1.0
SARDINE	186 / 193	170 / 193		27 / 34	0.5 / 2.0
SHARK-LIVER	165 / 190	120 / 140			3.0 / 16
WHALE					
SPERM(BODY)	195 / 198	100 / 140	0 /-5	20 / 24	1.0 / 4.0
SPERM(HEAD)	122 / 130	88 / 93		6 / 13	33 / 44
	140 / 144	60 / 76		11 / 12	39 / 45

WAXES	IODINE VALUE	SAPONIFICATION VALUE	MELTING POINT (°C.)	UNSAPONIFIABLE (%)
BEESWAX	7 / 14	88 / 98	62 / 66	48 / 56
CANDELILLA WAX	12 / 21	60 / 65	64 / 70	65 / 77
CARNAUBA WAX	8 / 14	79 / 87	84 / 91	50 / 55
MONTAN WAX	10 / 16	60 / 94	76 / 80	29 / 50
SPERMACETI	3 / 9	122 / 136	42 / 46	49 / 56
WOOL FAT(DEGRAS)	15 / 29	88 / 113	31 / 42	39 / 55

ABBREVIATIONS:
liq = Liquid acids of low melting point.
tr = Trace present -less than 0.5%

NOTES:
Butter fat contains 3% of Butyric acid in addition.

Figure 1 — Table gives chemical characteristics and fatty acid composition for the more important natural oils and fats as well as chemical data for waxes.

Of all the physiological and psychological complaints received by plant management pertaining to drawing compounds, two stand out. Industrial dermatitis can be caused by some types of lubricants, or by contaminated lubricants, and requires close attention by both suppliers and users. Bad odors may not be detrimental to health, but certainly do not make for pleasant working conditions, Products made from high quality raw materials, and which contain proper preservatives and germicides, are the best answers to these problems.

To comply with all of these requirements, plus a few more not discussed, usually involves a fairly complex

cation—such as "dry film lubricant" or "dip tank compound;" or the intended use—such as "tube drawing compound" or "cold extrusion lubricant." These terms are useful, and those containing some reference to composition do provide the user with a little information in a field where unreasonable composition secrecy has resulted in misinformation. However, sharp distinctions cannot be made, as a great number of the useful products fall into several categories.

There is one thing that is common to practically all good metal processing lubricants—they contain products derived from the natural fats, by simple refinement or by more involved processing. An understanding of

the nature of these fatty products will indicate the reasons that they are so useful as boundary lubricants. While this has been a discussion of drawing lubricants, much can be applied to other metal working operations (rolling, for instance), and this is particularly true of the part played by fatty lubricants.

Fats can be obtained, in various amounts, from nearly all growing plants, their fruits and seeds, and from animal and fish life. The carbohydrate material produced in plant life from carbonic acid and water, with the assistance of an ever present natural catalyst and sunshine, is converted into fatty matter. The composition of these fats varies considerably, and Figure 1 lists the characteristics of the more common and useful fats.

Chemically, the fats are mixed esters of saturated and unsaturated fatty acids. Across the top of Figure 1 will be found the names of the fatty acids, and opposite each natural fat is given the approximate percentage of these fatty acids which occur, in chemical combination with glycerine or other high molecular weight alcohols, in the particular fat. Some variations from these approximate compositions will result from different climatic and feeding conditions.

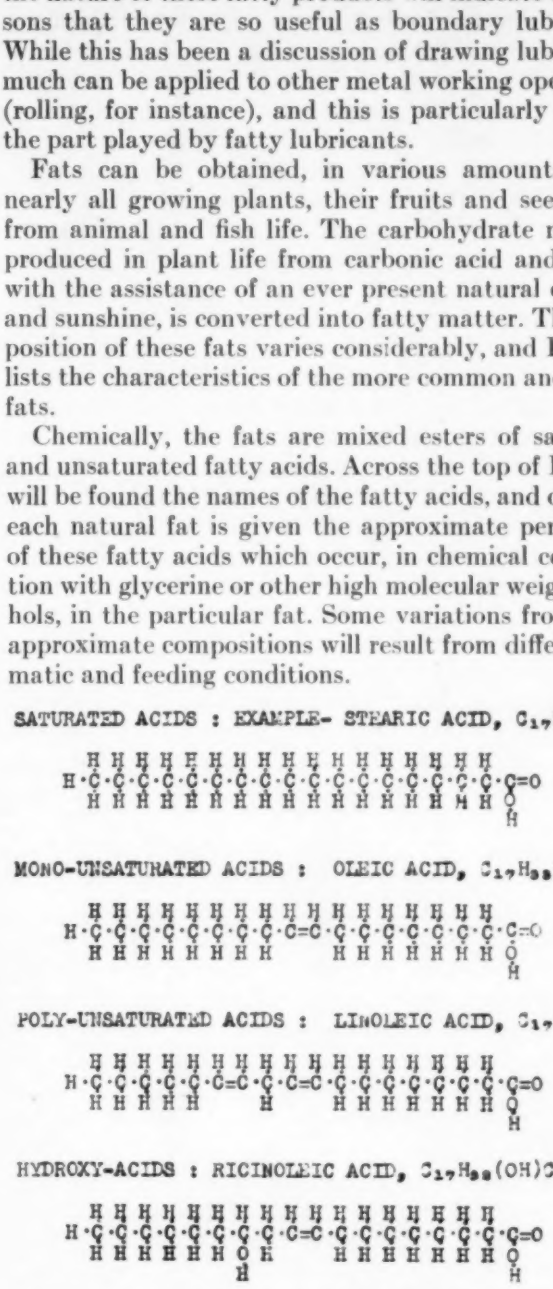

SATURATED ACIDS : EXAMPLE- STEARIC ACID, $C_{17}H_{35}COOH$
MONO-UNSATURATED ACIDS : OLEIC ACID, $C_{17}H_{33}COOH$
POLY-UNSATURATED ACIDS : LINOLEIC ACID, $C_{17}H_{31}COOH$
HYDROXY-ACIDS : RICINOLEIC ACID, $C_{17}H_{33}(OH)COOH$

Figure 2 — Chart illustrates how molecules are built up for several fatty acids.

On Figure 2 are found the structural formulas for several fatty acids. Those which are most familiar, stearic acid and oleic acid, are present in one form or another, in most good metal processing lubricants. These fatty acids consist of long hydrocarbon chains which terminate in a carboxyl group, or the "business" end of the molecule. The unsaturated fatty acids are missing one or more hydrogens.

If a saturated fatty acid is desired, this can be made from the unsaturated acid by hydrogenation, as shown on Figure 3. More interesting, from the standpoint of lubrication, is what can be done with these unsaturated fatty acids when they are oxidized and polymerized, as shown at the bottom of the plate. Using these fatty acids and their esters as building block, giant molecules can be made; their importance in boundary lubrication will be explained later.

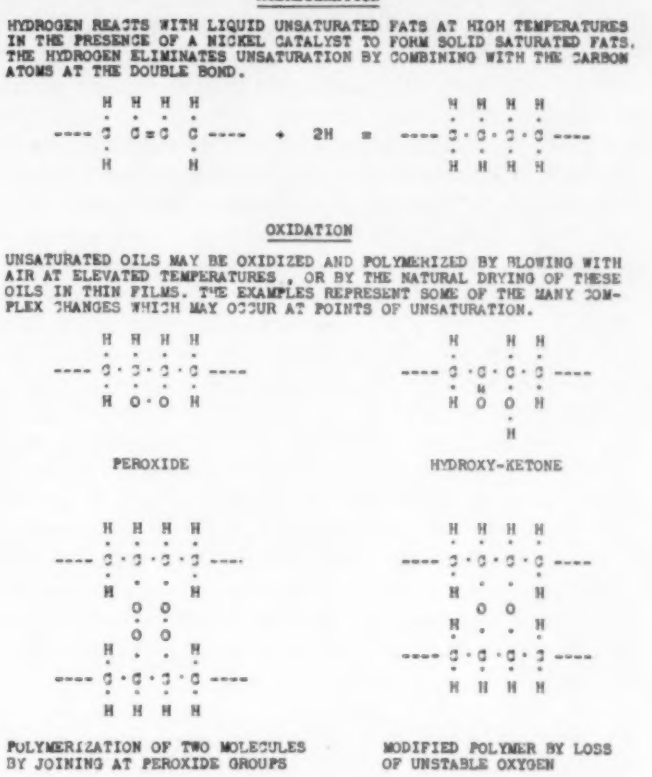
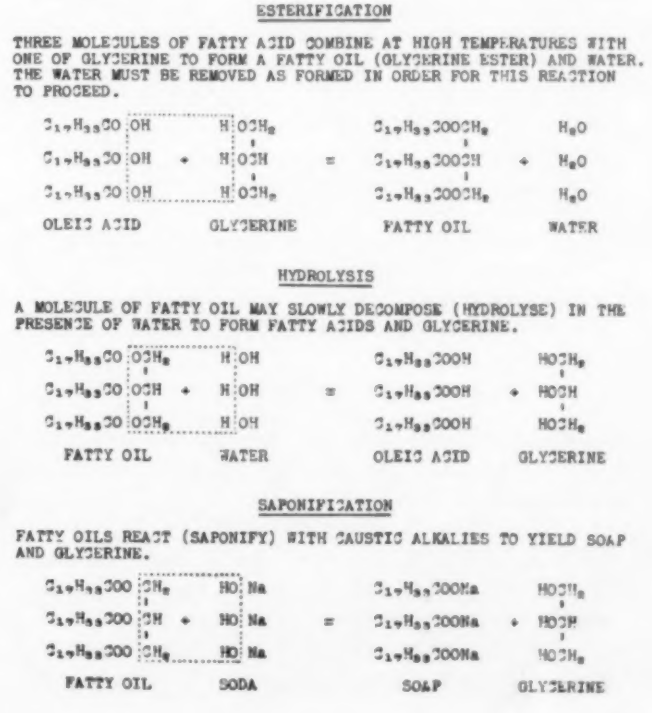

HYDROGENATION
HYDROGEN REACTS WITH LIQUID UNSATURATED FATS AT HIGH TEMPERATURES IN THE PRESENCE OF A NICKEL CATALYST TO FORM SOLID SATURATED FATS. THE HYDROGEN ELIMINATES UNSATURATION BY COMBINING WITH THE CARBON ATOMS AT THE DOUBLE BOND.
+ 2H =
OXIDATION
UNSATURATED OILS MAY BE OXIDIZED AND POLYMERIZED BY BLOWING WITH AIR AT ELEVATED TEMPERATURES , OR BY THE NATURAL DRYING OF THESE OILS IN THIN FILMS. THE EXAMPLES REPRESENT SOME OF THE MANY COMPLEX CHANGES WHICH MAY OCCUR AT POINTS OF UNSATURATION.
PEROXIDE
HYDROXY-KETONE
POLYMERIZATION OF TWO MOLECULES BY JOINING AT PEROXIDE GROUPS
MODIFIED POLYMER BY LOSS OF UNSTABLE OXYGEN

Figure 3 — Unsaturated fatty acids can be made saturated by hydrogenation or changed through oxidation.

It was said that the fats occur naturally as *mixed* esters. In some applications, a high degree of purity is desired. On the top of Figure 4 is shown the result of re-esterification—in this case, the combination of oleic acid with glycerine to form glycerol tri-oleate. Other alcohols may be used to obtain different esters of de-

Figure 4 — Changes in the molecule through esterification, hydrolysis, or saponification are illustrated in this diagram.


ESTERIFICATION
THREE MOLECULES OF FATTY ACID COMBINE AT HIGH TEMPERATURES WITH ONE OF GLYCERINE TO FORM A FATTY OIL (GLYCERINE ESTER) AND WATER. THE WATER MUST BE REMOVED AS FORMED IN ORDER FOR THIS REACTION TO PROCEED.
$C_{17}H_{33}CO.OH + H.OCH_2 = C_{17}H_{33}COOCH_2 + H_2O$
$C_{17}H_{33}CO.OH + H.OCH = C_{17}H_{33}COOCH + H_2O$
$C_{17}H_{33}CO.OH + H.OCH_2 = C_{17}H_{33}COOCH_2 + H_2O$
OLEIC ACID GLYCERINE FATTY OIL WATER
HYDROLYSIS
A MOLECULE OF FATTY OIL MAY SLOWLY DECOMPOSE (HYDROLYSE) IN THE PRESENCE OF WATER TO FORM FATTY ACIDS AND GLYCERINE.
$C_{17}H_{33}CO.OCH_2 + H.OH = C_{17}H_{33}COOH + HOCH_2$
$C_{17}H_{33}CO.OCH + H.OH = C_{17}H_{33}COOH + HOCH$
$C_{17}H_{33}CO.OCH_2 + H.OH = C_{17}H_{33}COOH + HOCH_2$
FATTY OIL WATER OLEIC ACID GLYCERINE
SAPONIFICATION
FATTY OILS REACT (SAPONIFY) WITH CAUSTIC ALKALIES TO YIELD SOAP AND GLYCERINE.
$C_{17}H_{33}COO.CH_2 + HO.Na = C_{17}H_{33}COONa + HOCH_2$
$C_{17}H_{33}COO.CH + HO.Na = C_{17}H_{33}COONa + HOCH$
$C_{17}H_{33}COO.CH_2 + HO.Na = C_{17}H_{33}COONa + HOCH_2$
FATTY OIL SODA SOAP GLYCERINE

sired characteristics. In the presence of water, the process is reversed, and the fatty acid obtained from the ester by hydrolysis. At the bottom of Figure 4 is found the result of reacting the fatty ester with a strong alkali to form soap.

All of these things have a bearing on the functioning of the fatty lubricant. Of utmost importance is the fact, first proven by the classic research of Langmuir, that the fatty acids orient themselves with the carboxyl group (the active end of the molecule) at the surface. This results in the formation, on the tool and work piece, of a film of fatty acid molecules which stand up from the surface, much like the pile of a carpet. The bond between the active end of the fatty acid molecule and the metal is a very tenacious one; the long hydrocarbon chain sticking up from the surface is the separator that reduces the tendency towards welding, hence the longer this chain, the better. These layers of fatty acid molecules build up, on the surface, to a considerable thickness—several hundred molecules thick. While there is a tenacious bond to the metal, which gives a good separation, the long hydrocarbon chains lack attraction for each other, and this results in low lubricant friction, or a high degree of slip.

This mechanism is affected by temperature, time, concentration, surface condition, contaminants, and it is important that these application details be controlled if optimum results are to be obtained.

The fatty esters, which may be present along with the fatty acids, have a polar nature, and behave in a somewhat similar manner. In addition to this, the esters liberate fatty acids, serving as a reservoir to replace the acids consumed. Polymerization of the fat results in large molecules, with increased separating ability, and the higher internal friction of these polymers provides less slip in those applications where this is desirable. Removal of the fatty lubricant may be accomplished with ease, as the fats are soluble in degreasing solvents or saponify and emulsify readily in alkali cleaning baths.

When processed and applied properly, alone or in combination with other agents, a great deal can be done with fatty lubricants. For the past four years we have been supplying the steel industry with a perfectly satisfactory replacement for imported natural palm oil, made from domestic fats, uniform in its characteristics, and at a considerable saving in average cost. It is now possible to dip bare high carbon steel wire or rod in a fatty drawing lubricant, dry it, and draw it through six dies on a continuous bench at top speed, (about 1200 fpm). This is done without any soap or other lubricant applied at each individual die; wire quality and die life are at least as good as with the more conventional practice, and the lubricant cost is much less. The dry soap dust in the wire mill is eliminated. These are but two examples of improvements which can be made by cooperation with practical application of the fundamentals we have discussed.

DISCUSSION

PRESENTED BY

ROBERT C. WILLIAMS, Director of Research, The Ironsides Co., Columbus, Ohio.

ALLEN A. BROWN, Reilly-Whiteman-Walton Co., Conshohocken, Penna.

E. L. H. BASTIAN, Senior Engineer, Shell Oil Co., New York, N. Y.

WALTER A. SMIGEL, General Manager, R. H. Miller Co., Homer, N. Y.

HARRY N. DAVIS, R. H. Miller Co., Homer, N. Y.

D. E. WHITEHEAD, General Lubricating Engineer, Crucible Steel Co. of America, Pittsburgh, Penna.

H. E. MARTIN, District Sales Manager, E. F. Houghton Co., Philadelphia, Penna.

JAMES McELGIN, Manager Metal Working Department, E. F. Houghton Co., Philadelphia, Penna.

Robert C. Williams: Some years ago we found that you are not always working with what you think you are working with. You may have oxide films, and sometimes you cannot do much about those. In order to evaluate a lubricant, you may use a piece of metal which may have been sitting around in the mill for a while and it becomes contaminated from materials carried in the atmosphere, dust, fumes, various sorts of materials. You are not working with the metal. It became very apparent to us when we were running some friction experiments on wire drawing lubricants. We soon found that we had to chemically clean the wire before we performed any experiments, because the results were erratic, so we chemically cleaned them insofar as atmospheric contamination is concerned, and I found out a little more than we had before we started doing that.

Another point which I had hoped Mr. Brown might dwell upon a little more, is the use of wax lubricants, or waxy films. They are coming to the fore more and more. Possibly we started on that before we should have. We had trouble getting hearings and trials in the earlier days and found that wax, as Mr. Brown points out, is affected in its performance very much according to the temperature with which it is used.

It was very enlightening to us that, if we used a wax at a temperature above its melting point, that we gained very little over using an oil of a comparable viscosity at the temperature at which we used the wax. But, if we always had the drawing operation started initially at a temperature where your wax was a solid, we got an effect which we likened to skating on ice. The wax suddenly melted at the point of contact and friction was reduced very, very substantially. As a matter of fact, we did not believe what we were getting for a while.

I would like to ask Mr. Brown if he has found anything similar to that.

Allen A. Brown: On mineral waxes I could understand very definitely that the material in the solid condition would offer a lot over the materials in the liquid

condition. But our experience has been on fatty waxes that the heat of any operation has a tendency to dissociate the ester, to break away, or split away some of its fatty acid from the ester, and give the formation of metallic soaps, which have proven in our experience to give better lubrication than solid mineral waxes.

E. L. H. Bastian: In general, the fundamentals referred to are certainly applicable as discussed. However, it would be interesting to have Mr. Brown's views on the value of cooling as a primary function of the drawing lubricant.

While certainly we must agree that boundary lubrication is more important than fluid or hydrodynamic lubrication in metal drawing, it may be worthwhile here to mention the effects of viscosity in tube drawing applications. These have been noted practically by many shop men and experimenters alike. Mr. Brown's comments on this point would be appreciated.

He mentions the adverse effects of alkaline lubricants on zinc coated or galvanized work. The same comment should probably be extended to apply also to drawing of aluminum.

With regard to the classification of drawing lubricants as discussed by Mr. Brown, I would like to make a point here about those lubricants that ordinarily are

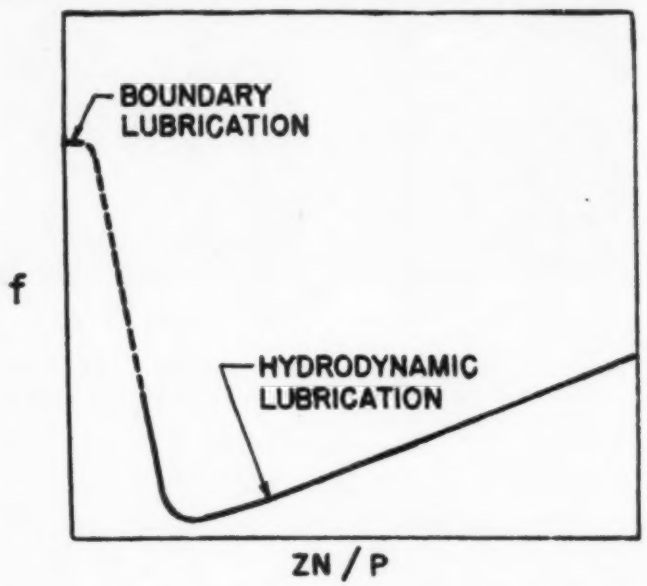


Figure 5 — Curve shows that friction varies as a function of pressure, velocity, and viscosity.

considered boundary lubricants employed in drawing applications, breaking them down somewhat along this pattern. First of all, considering the polar compounds, as he pointed out, they have their effect by absorption on the metal surface and essentially function by a continual shearing through the asperite peaks on the roughness of the surfaces. The fatty acids, the fatty oils are typical of these purely polar compounds.

The second group of drawing lubricants which you might consider as another group or entity for classification purposes, would be the so-called "polishing agents." These polishing agents act over and above the simple effects of the polar compounds by chemical action on the metal surface. Typical of polishing agents would be tricresyl phosphate, for example, where a mild chemical action occurs to prevent excessive welding or tearing or rupture of the metal surface.

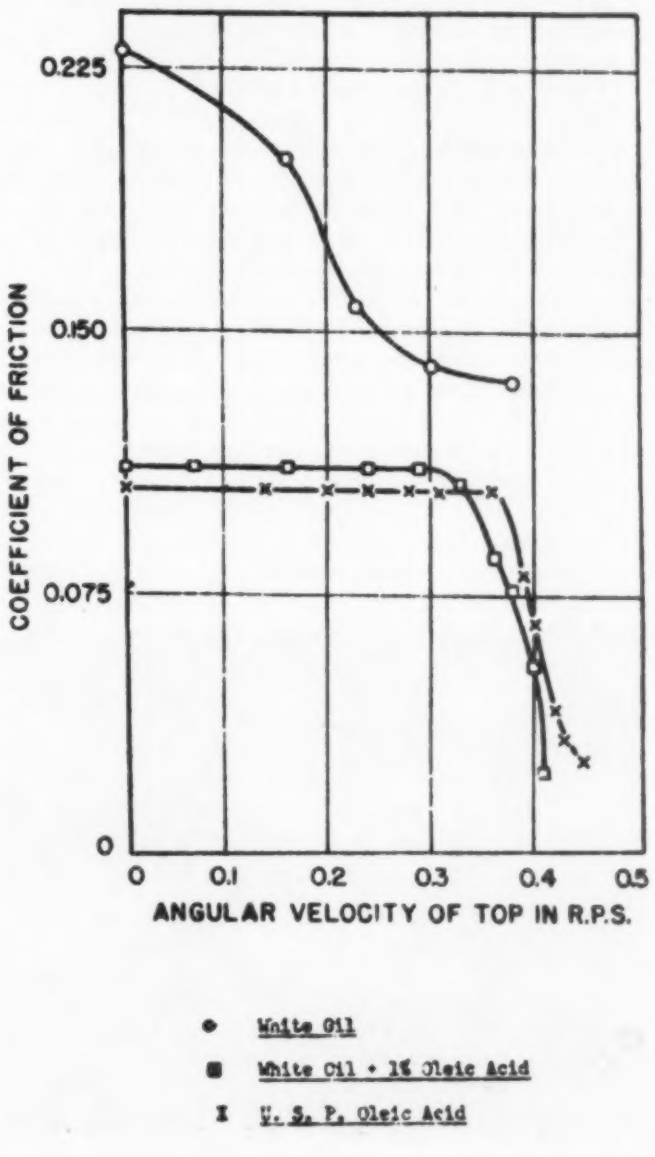
In the third group of drawing lubricants that might be classified as such, we consider the true extreme pressure lubricants, and there I have in mind the types of lubricants which act through rather drastic chemical action on the metal surface to form, for example, sulphide-chloride films in the case of sulphur-chloride compounds.

These three classifications do not necessarily all include the use of fatty oils, and, while the employment of fatty compounds, natural fats, and fatty acids in drawing lubricants is quite common, I believe it is fair to suggest that there may be other formulations which are as effective, or more effective, under certain conditions of drawing.

I have several illustrations which more or less confirm some of the points Mr. Brown made on the subject of boundary lubrication.

Figure 5 shows the effects of friction as a function of pressure, velocity, and viscosity in the regions of boundary and hydrodynamic lubrication. The ratio here, ZN/P, is a ratio indicating the effects of, first of all, viscosity

Figure 6 — Friction is shown to be a function of the velocity in the four-ball top test.

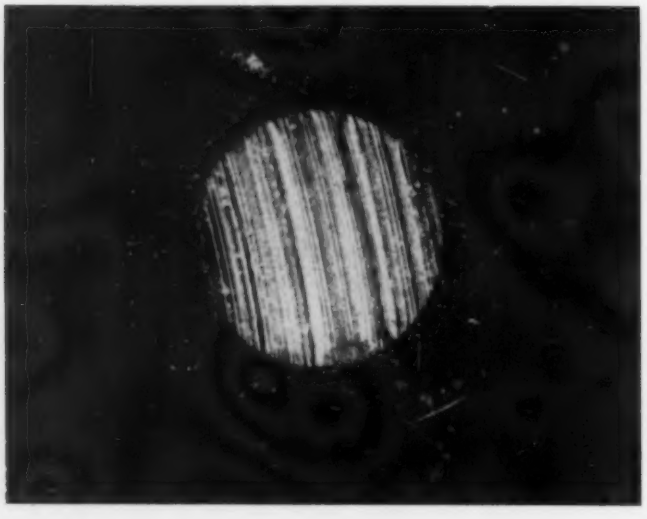


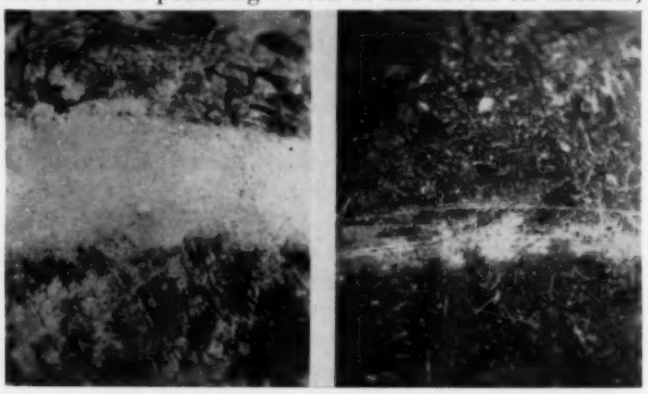
represented by Z, which is absolute viscosity, and N representing the speed of motion of the two surfaces in contact, which in the case of drawing, may be the die surface, or metal surface, and which is ordinarily represented in feet, and P representing the pressure between the two contacting surfaces in psi. The coefficient of friction is equal to this ratio times a constant to adjust for the units involved. The point that I think is of interest here in connection with Mr. Brown's discussion of modern lubricants is that in this range of hydrodynamic lubrication, the ratio holds. In other words, as viscosity increases, as speed increases, the coefficient of friction increases. As the pressure increases, the coefficient of friction decreases. Various experimenters have shown, there is a range, indicated by some as the quasi-hydrodynamic range of lubrication, wherein there is a transition in the usual relationships that occur in hydrodynamic lubrication. Some investigators indicate a condition of boundary lubrication where velocity becomes zero. In the work of investigators like Larsen and Vesper, by laboratory means the effect of metal pickup is indicated reflecting a condition of welding, where instantaneous welding and breaking of welds, as mentioned by Mr. Brown, occurs. The frictional coefficient remains constant during boundary lubrication for the reason the only condition that applies is a condition of the surface. As Mr. Brown pointed out, the condition of the surface is a very important indication of the degree of drawing lubrication.

Figure 6 is intended to indicate the results of some work with which some of you may be familiar, the use of the four ball type machine, wherein the coefficient of friction under various conditions of lubrication are given. Under given conditions of loading and with decreasing velocity of the spinning top, the coefficient of friction with various lubrication media changes as indicated by this chart. With a simple mineral oil such as refined white oil, the friction coefficient increases as the velocity decreases and goes up into the ranges as you see here. With the addition of even a small concentration of fatty acid, one per cent oleic acid, with decreasing velocity, the friction coefficient remains constant going down to zero velocity, indicating the boundary lubrication effects of the fatty acid. And with 100 per cent oleic acid, a typical fatty acid, the same phenomenon is observed.

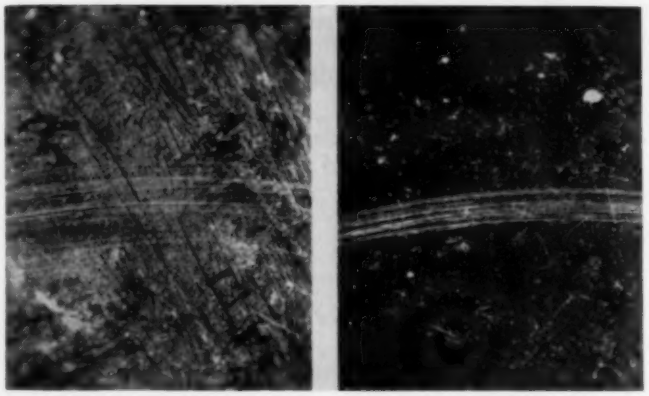
Figure 7 indicates the condition of wear which occurs between two metal surfaces below the point of seizure, and shows a polishing action of one metal on another,

Figure 7 — Photomicrograph shows wear scar on lower ball below the point of seizure in a two-hour test at a 15-kg load.





A. White Oil B. Ceresin wax + 5% Oleic Acid



C. Palm Oil D. Lard Oil

Figure 8 — Metal pick-up studies. Photomicrographs of wear tracks are shown for steel vs aluminum on upper balls of four-ball wear top.

but without actual seizure or tearing of the metal surface. This sort of condition would occur in drawing with the use of such lubricants as the polishing agents, for example.

Figure 8 shows the effect of metal pickup of soft metal on a harder metal surface and would be representative, for example, of the drawing of aluminum with steel die surfaces. It shows, in this case, the pickup of aluminum on the top steel ball of a four ball apparatus, the top ball being harder than the lower three balls, rotated under certain conditions of speed, and lubricated with various lubricants as captioned on the figure. The use of a natural wax, such as ceresin wax, plus a small amount of fatty acid, shows considerable improvement in minimizing the pickup.

The use of two commonly known and rather typical fatty oils which have pronounced boundary lubrication value, palm oil and lard oil, show even more diminished pickup of the soft metal on the hard metal surface.

Walter A. Smigel and **Harry N. Davis:** We would like to take the liberty to compliment Mr. Brown on his paper in which he has very ably expounded upon the theories and fundamentals of metal drawing lubricants.

We were very interested in Mr. Brown's references to the lubricant coating applied to wire by dipping and drying, thereby eliminating die box lubricants.

A couple of years ago, Mr. Verner and I presented a paper "Metal Drawing Lubricants for Wire, Tubing and Sheet Metal Steel," 1951 Proceedings AISE, p 244 in which we stated that we had obtained very excellent drawing results using lubricant coatings. For example, low carbon rod was drawn as many as 12 holes. However, we felt that the process had limitations because of the usual mill variations. We nevertheless said at that time that we felt that this method warranted further research.

At the present time, we think we are considerably less enthusiastic about this process having made trials a number of times during a period of 20-some years. We think one reason for our feeling is that the process is not flexible. It would take a number of dip tanks to satisfy all the requirements for various wire finishes demanded by the wire trade.

Secondly, if the coating is destroyed during drawing for any reason, other than the efficiency of coating itself, and for reasons such as poor steel, irregular rods, worn dies, or the other many conditions that we find in everyday wire mill operation, if the coating is destroyed, it cannot be re-established as is usually the case with die box lubricants. We may be wrong, but we do not think that this type of process will substantially displace the regular die box lubricants for continuous drawing.

Allen A. Brown: I would like to give some of the data that we have procured over the past six months on the product to which I am making reference. The material that we have processed is not a matter of five coils or ten coils or anything of that nature. The volume of material that has been processed in this manner is considerable. Many tons have been processed this way.

Mr. Smigel made reference to success on low carbon wire. Now, I take that to mean that he encountered his difficulty on high carbon wire. For the benefit of you who are not familiar with this particular product, all the work that we have done to date has been on high carbon wire and rod. A typical reduction for 1060 steel, would be a rod size of 0.106, finish size 0.040, a speed of 1,200 fpm in six draws. One reassuring feature of the lubrication job being done is that there is an accumulation of lubricant in the mouth of each die providing lubricant for each reduction.

Continuing further on Mr. Smigel's comments regarding increased tank requirements for the use of this particular operation, the use of this particular product entails the use of absolutely no additional equipment. Practically all wire mills have a borax tank. This particular product is used in conjunction with the borax tank.

Walter A. Smigel: I was wondering if with this particular lubricant you could, for instance, produce welding wire? Can you produce extra-clean, extra-bright wire?

Allen A. Brown: The wire is no brighter than wire normally drawn through soap powder.

Walter A. Smigel: Can you produce nail wire, cold-heading wire? My reason for asking is to point out that some types of wire such as rope wire can be made with one tank, but many different compositions and many tanks would be needed to produce the various types of finishes for wire.

Allen A. Brown: People who have tried this material feel the finish is comparable to the finish they are getting from borax coated wire. In many operations people are resorting to a borax dip. They are getting away from the lime as much as possible except in operations where the customer insists on a lime coated wire, but in applications where borax was previously used, this particular product has replaced it and has also replaced the use of lime on that particular coated wire.

Walter A. Smigel: Wire produced with a borax finish has some limitations, for instance, its use is questionable on some grades of spring wire. I did not want to give the impression from my previous comments that this particular process does not work; either high or low carbon wire being easier to draw down with lubricant coatings than rod. However, wire mills have many variables and at times have their ups and downs. Therefore, we do not believe lubricant-coatings will become the universal method for drawing rod and wire.

D. E. Whitehead: The reactive type of lubricant is particularly interesting to many of us engaged in reducing and drawing alloy steel products since optimum performance is adamant. Looking toward our texts on modern gear lubrication, we find a wide variety of certain re-active type lubricants applicable to metal drawing operations, and the full text has certainly not been explored at this time.

We find with interest that certain types of reactive lubricants that have been indicated for successful high load gear lubrication show value as metal drawing lubricants, yet these same species would be frowned upon as definitely non-applicable for the reduction of strip or sheet alloy rolling.

There are also those reactive types of lubricants that we find applicable to sheet and strip alloy reduction and to metal drawing operations which would be regarded outside of any consideration as gear lubricants, yet these lubricants are all typed within the scope category of reactive type lubricants. These facts or contradictions all lend fascination to any exploration of the known field of reactive lubricants for possible new application of existing lubricants or the development of new lubricants for alloy wire drawing.

The increasing use of diamond dies for alloy steel wire drawing brings to our attention new requirements in lubricants for the successful drawing of alloys also to effect reasonable economies in diamond die life. It appears that the reactive type lubricant is definitely indicated for this work, but leaves us concerned about the theoretical logic from the standpoint of a fitting selection of a reactive lubricant when applied to prevent welding between an alloy steel wire and a diamond die.

Certainly the field of application of the reactive type lubricants to alloy steel reduction by rolling and drawing is in its infancy and like most infants is attracting attention and developing demands.

I recently received a communication from one of our new wire mills reporting on the reactive type lubricants

suggested for test. Very fine reductions were reported, but we were also asked if we had a customer that might require a couple of coils of alloy wire having a brilliant olive green cast.

H. E. Martin and **James McElgin:** In a general discussion of this nature, it is not always possible to cover the detailed characteristics of the many boundary lubricants. Mr. Brown has covered, in terms of coefficients of friction, the differences between simple lubrication as supplied by continuous oil films and the boundary lubrication which applies in the working of metals.

Liquid lubrication can exist up to a pressure of about 4,500 psi between adjacent metal surfaces. Boundary lubrication occurs between unit pressures of 4,500 and 450,000 psi. The average deep drawing operation involves pressures up to 10,000 psi. If there is any appreciable ironing of the metal, the pressures may be as high as 100,000 psi. Wire drawing, tube reducing, and cold extrusion of steel produce pressures in the range of 150,000 and 450,000 psi.

The various factors involved in a drawing operation are so complex that it is often impractical to select a drawing lubricant without an on-the-job analysis of the particular requirements by personnel with an expert knowledge of metal shaping operations and the formulation of lubricants applied to drawing practices.

Mr. Brown has discussed the development of a synthetic substitute for palm oil in cold reduction mills. There are many other new concepts in the lubricants used in the boundary lubrication involved in the cold forming and shaping of metals.

Among the new developments is the use of new extreme pressure agents and combinations. These have permitted in many operations the use of light-bodied oils or emulsions in place of the heavily pigmented products previously employed. Where a pigmented material is required, new colloidal pigments are being utilized. These pigments are about 5 microns in particle size in comparison to a size of 200 microns in the finest grade of whiting. These finer pigments cause less die wear. They produce better finishes with less possibility of scratching. They remain suspended indefinitely in water mixtures and can be cleaned from the work as readily as a soluble oil.

On extremely heavy drawing operations where pigmented compounds or surface reactive extreme pressure agents cannot be used, such as on work which is to be vitreous enameled, polar type lubricants are being employed.

Lubricants having polar activity have made possible extremely heavy operations such as the drawing of one-piece steel bathtubs and sinks without intermediate anneals or the use of pigments or extreme pressure agents. Polar lubricants consist of molecules having two parts, one charged negatively at the end of a long chain and the other end with a positive charge similar to the positive and negative ends of a small magnet. These lubricants are effective because these molecules are attracted and held in position on the metal surface by their electrical charges. The initial layer of molecules is attached so strongly to the metal surface that high shearing stresses are required to displace it. Other layers of molecules are built up by electrical attractions on the surface of the first layer. Under the most severe drawing conditions, all but the initial layer is likely to be displaced. However, in most cases the initial layer of molecules is sufficient to provide adequate lubrication and to prevent welding.

The trend in many high production drawing operations is to the so-called "dry film" lubricants. In this practice, the blanks or sheet stock are immersed for a short period in a heated dilute water solution of the drawing compound. They are then withdrawn and allowed to dry by means of the residual heat remaining in the metal. In some cases a short baking cycle is used to evaporate the moisture remaining on the surface. After the evaporation of the moisture, a dry film of the lubricant, about 0.001 inch in thickness, is left on the metal surface. In some cases the film is composed of a mixture of crystalline alkalies such as borax and trisodium phosphate.

With another type of compound, the residual film is composed of an alkali mixture bound to the metal surface in a matrix of regenerated cellulose. The complex mixture of alkalies used produces a deposition of crystalline particles of a controlled size and increased adhesion to the metal surface. Mixtures of alkalies and high titre soaps employed in wire drawing practice are also being used in dry film drawing lubricants.

Another new type of dry film lubricant is composed of a mixture of regenerated cellulose and high melting point waxes possessing exceptional lubricating properties. The dry film which is produced on the work is very tough and adherent. Parts can be stored for indefinite periods before and after drawing without any danger of rusting or deterioration of the drawing qualities of the coating. This film consists of a matrix or sponge of regenerated cellulose tightly bound to the metal surface. This cellulose acts as a solid lubricant which will withstand the high pressure produced by successive reductions. This sponge or matrix is filled with high melting point waxes which are forced to the surface by the die pressure. This supplies any required additional lubrication.

The matrix of cellulose prevents the lubricating wax from being stripped away by the die pressure. A modification of this particular type of dry film drawing lubricant contains a percentage of colloidal pigment. This combination is highly efficient on applications where the ironing action is severe as in the cold drawing of bar stock.

Mr. Brown has discussed the importance of the easy cleanability of the drawing lubricant from the work. In the field of palm oil substitutes in the cold reduction of steel sheet, coordinated research recently completed indicates the possibility of a satisfactory cold rolling lubricant or palm oil substitute which can be cleaned from the sheet stock by cold cleaning practices. This cold cleaning practice, to be used in the present continuous cleaning lines, does not involve the use of solvents.

The use of cold water solution eliminates the necessity of the steam or any other heating in the present cleaning lines. The savings in the cost of heating the cleaning solution will approach one cent per gallon per day of the solution capacity of the system.

MAKING THE FOREMAN PART OF MANAGEMENT

By MILES ROBSON
Training Director
National Foremen's Institute
New London, Conn.

. . . . more effective use of foremen may be obtained through increasing acceptance of them as an actual part of management . . . .

▲ MAKING foremen a part of management is one objective on which most executives can agree. Every year, additional companies join the ranks of those who practice, as well as preach, this organizational concept. But there is considerable room for improvement: and it should be said from the outset that the goal cannot be reached easily. This difference in types of foremen lies in the degree to which a foreman "manages."

But there are other considerations—seldom spelled out in any supervisor's job description—which determine whether he is in fact part of management. Putting it simply, he has that status:

1. If his superiors treat him as such.
2. If his subordinates regard him accordingly.
3. If he himself feels he belongs in the management group.

Three separate sets of attitudes are involved and whatever management does in the interest of improving the quality of supervision must give equal weight to these factors. There is little use trying to "build up" the foreman in the minds of the rank and file if top management's own acts reduce his stature, or if he lacks the information and authority which he should have as a member of the management group.

SELF-ANALYSIS SPARKS THE PROGRAM

"Do we really treat our foremen as executives?" This question is the logical starting point in shaping the foreman improvement program. It is easier to answer this question in a smaller company than in bigger organizations. There are many concerns employing anywhere from 50 to 500 people where the president or general manager knows personally every foreman in the shop. He can decide very quickly whether the performance and competence of his foremen come up to his expectations; and if the answer is "No," he can take direct action. But where there are several levels of management between the top executive and the foreman, both appraisal and correction of the foreman's functions are harder to carry out. It is always harder for the top executive to induce intermediate executives to change their attitudes than it is to change his own.

There is no simple formula which applies to all instances. Circumstances differ from plant to plant, and nobody yet has defined a pattern of human relations which would be effective or acceptable everywhere. But certain elements characterize all such relationships, and their presence or absence gives a clue to analysis and action. Some of these elements are functional and administrative, while others are predominantly social.

Recognition of the foreman, in a human relations sense, boils down to treating him as a part of the executive team—not as something quite distinct and well removed from the ranks of management. Many executives only use picnics and other social occasions to mingle with their foremen, but to the majority of foremen this social recognition is just frosting on the cake.

Working relationships within the plant are what really count. Here are some of the ways in which companies are making their foremen actually part of the management team:

1. By giving them an opportunity to shape, or at least to influence, decisions affecting their operations. Departmental committees, where mutual problems are worked out, give foremen who serve on them a sense of participation. Devices of this sort are being used effectively in many fields.
2. By reviewing policy changes with the foremen, as a group, before putting these changes into effect. There are many cases on record where "hashing out details" in advance has saved time and money by forcing revision of a plan before, and not after, certain damage has been done.
3. By giving supervisors a clear picture of the company's external operations, such as sales and advertising, branch installations, capital considerations, competitive standing, and the like.
4. By including the foremen in "sideways communication"—the network of memos, reports and bulletins which too often are confined to higher officials. Some firms have found it helpful to digest such information for the supervisors, to give them a condensed daily report on matters which directly affect their operations.
5. By giving supervisors an active part in establishing standards of practice and performance.
6. By helping the foremen, through special training, to do a better job of human relations and work administration.

Steps like these lift foremen out of the "second class citizenship" of the industrial community.

GIVING FOREMEN "STATUS" IN WORKERS' MINDS

What workers think of foremen is every bit as important, however. Supervisors are in a difficult spot, alienated in a sense from the very people with whom they spend most of their working time, and who are quick to notice anything which takes the boss "down a peg." A common grievance among foremen is that management favors the shop steward, by-passing the company's own "management representatives." Another complaint is the failure or unwillingness to back up the foreman in disciplinary situations. Such practices lower the supervisor's importance in the worker's eye, and naturally keep him from feeling that he is a part of management.

I have heard more than one foreman complain that executives respect each others' prerogatives, but when they are on the factory floor they give orders to the first person they meet. "They carry on long conversations with my men with no concern as to whether they are bypassing me or not," another foreman commented. The foreman is extra sensitive in such cases because management has not given him enough authority and responsibility of a tangible sort. If he had to be consulted in a matter affecting his men, such as hiring or firing, and that consultation was definite, he would be less concerned with minor infringements into his affairs by higher executives.

Here are some other ways in which management, by its actions, can lift foremen in their workers' estimation:

1. Encourage foremen to make their own decisions, wherever possible. Cut down the supervisors' need to tell employees, "I don't know. I can't promise. I'll have to talk with the boss."
2. Make each foreman supreme in his own department. Go through him, not around him, when dealing with his subordinates. This means members of the 25-year club, even if they did break in the "big boss" when he first came with the company. It includes the treasurer's nephew, who is working his way up, and also the shop steward. It also means tightening up "informal" methods which encourage channel crossing and detouring around the foreman.
3. Make the foreman responsible for workmanlike behavior on the part of his subordinates. This includes authority to admonish, punish or even discharge those who violate the rules—powers which supervisors prefer not to exercise unless they have management's support. In cases where foremen make mistakes in judgment, it is wise to help them "save face" by giving them a chance to reconsider the verdict, rather than overruling them in public.
4. If management has criticisms or warnings to express to a foreman, they are better said in private. Differences, too, should be ironed out behind closed doors.
5. Start new employees off on the right foot by giving the foreman a major part in the orientation process, so they will look to him for guidance and assistance.

Managers who plead inability to take such measures, because the foremen "aren't ready" or "seem unqualified," are not making optimum use of supervision. They are paying the price for poor selection and inadequate foreman training. They may refer to their foremen as "part of management," but the employees remain unimpressed—and withhold their seal of approval.

THE FOREMEN'S OWN FEELINGS

How the foreman feels is the product of these two forces, plus some evaluations of his own. He knows how foremen fare in other plants, and has no trouble comparing his functions, responsibilities and powers with theirs. As a resident, church goer, civic club member and neighbor, he knows how he and his fellow foremen rate in the community. If he is treated as an executive by those beneath him and above him, he thinks like one and acts like one, both in plant and without.

This is particularly true since the pay differential problem disappeared, as it largely has. As the Institute's survey showed, foremen's salaries run from ten to 25 per cent above the take-home of hourly employees whom they supervise. We believe this economic indicator points toward more intelligent and effective use of foremen, including their unquestioned acceptance as a part of management.

SUPERVISION'S PART IN EFFECTIVE COST CONTROL

By ARTHUR C. CROFT
President
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. . . . in the final analysis, the foreman is the tool through which management can accomplish efficient and profitable operations . . . .

▲ SUPERVISION can make or break a company's efforts to keep costs at a healthy level. No matter how carefully management lays its plans for cost control, such measures are effective only to the degree that supervision carries them out. Making cost controls work rests heavily on the foreman—mouthpiece of management and interpreter of company policy. He is the one who gets things done.

"Getting things done" is only a rough approximation of the foreman's job. "Getting things done more effectively" is a more dynamic definition. Few operations in any plant have reached the point where further improvement is impossible. Management's first move toward effective cost control is to sell this concept to front-line supervision.

Once this cost-minded viewpoint is accepted, every foreman can utilize the ten basic methods which make cost control really click, by:

1. Analyzing improvement possibilities.
2. Installing better production methods.
3. Increasing productivity.
4. Reducing the cost of operations.
5. Keeping accidents to a minimum.
6. Improving equipment and facilities.
7. Adhering to budget limitations.
8. Enforcing quality control.
9. Campaigning aggressively for effective cost control.
10. Promoting employee morale.

Most foremen know from experience the quality and kinds of material to be used, the tolerance-margins to be held, and how much and what kind of work they can count on from each of their employees. The supervisor has seen all of the operations that take place in his department performed many times; often he has done them himself. To his own experience, management can add the knowledge of plant engineers, plus information from trade journals, and industrial books and manuals. The foreman conference is a tested method for giving him valuable pointers by showing him how other foremen are doing similar jobs. Some of the best ideas come from the employees, if their foremen are receptive to suggestions.

Incentive is a valuable tool in selling cost control to foremen. Our studies prove that compensation is a vital factor; the foreman whose salary is less than the ordinary workers' wages, plus overtime and other differentials, is apt to give half-hearted support to management's objectives. Money alone is only part of the story—foremen must feel they are really part of management. They must be "let in on" management's thinking, and be given a share in forming the policies which they help to implement. "Will management back me up when I make decisions?" is one question to be answered affirmatively whenever a situation arises.

In other words, foremen feel free to proceed with cost-control efforts:

1. When they can behave as an integral part of management.
2. When they have a clear understanding of the com-

pany's cost-control policies, and realize exactly what management wants them to do.

3. When their lines of authority are clear of entanglements.

DIAGNOSING OPERATIONS

Analyzing improvement possibilities, by making an on-the-spot breakdown of the job routines, is the logical starting point for supervision. By systematically surveying each job in his department, the foreman can discern: (1) Why is it necessary? (2) What is its purpose? (3) Where and when it should be done? (4) Who should do it? (5) What is the best way to do it? With the job so cut apart, every detail can be seen clearly, and any reason why it is not efficient can be nailed down. If a bottleneck exists, or if a job is being done haphazardly or in confusing manner, the supervisor can reconstruct it on a more efficient basis.

Installing better production methods, in order to increase production, is the second step toward holding costs down. By lining up equipment so materials can be handled more swiftly, or not have to be backtracked, the foreman may save wear and tear on materials, as well as production time. Simplifying a complicated assembly process, or cutting down on paper work, will help. There are human factors, too: supervision should consider any steps that will make for better teamwork —as by eliminating personality conflicts between employees, and overcoming interdepartmental frictions.

Increasing productivity is a fundamental goal of supervision. The foreman knows how many units each subordinate is getting out. If he feels a certain worker is not producing up to par, or could stand improvement, he should investigate the particular job routine from the standpoint of: (1) make-ready; (2) do; (3) put-away. Make-ready and put-away are non-productive jobs, and improvements often result from an effort to cut them down.

Every operation should be set up in accordance with the principles of time and motion. Most foremen, after studying the sequence of operations carefully, and watching an operator's motions, can find ways to eliminate unnecessary movements. Each motion of the worker should pay off with maximum possible results.

Even when each job is simplified in a way to minimize the skill and effort required, there are always some that will be more difficult than others. Knowing the capabilities of his workers, the foreman can assign those with the least skill to the simplest jobs, thereby releasing his best workers for the more difficult functions.

Naturally, each workplace must be arranged in such a way as to insure the highest possible efficiency. All needed tools, parts, jigs, fixtures, etc., should be on hand, or be easily and quickly obtainable. Supervision can also see: (1) that tools in use give maximum economy of effort, and cause a minimum of fatigue; (2) that materials handling equipment, such as mechanical trucks and hoisting devices, are available when needed; and (3) that such hindrances as poor lighting, improper housekeeping, bad ventilation, and faulty machinery are corrected.

Manpower utilization is a many-faceted problem. Good supervision keeps labor costs down by seeing that workers are on the job at all proper times. If time is being lost due to lateness or early quitting, the causes must be rooted out and corrective action taken. Increased supervision during the first and last ten minutes of every working period will save considerable time, as will preventing idleness, gossip and horseplace.

Maintenance is another vital factor, because well kept equipment turns out more production of better quality, and is less apt to cause accidents. It also gives longer service. The foreman may find it advisable to observe the maintenance crews, or even to requisition a special employee to keep his machinery in top working order.

SAFETY PAYS DIVIDENDS

Keeping accidents to a minimum is an important part of cost control. Foreman should enforce the constant use of safety devices. Workers sometimes become careless when they try to speed up production, or they may deem some devices not worth the bother, and are tempted to put them aside. Supervision can overcome this laxity by constantly stressing "Safety First."

Improving equipment and facilities involves heads-up thinking on the part of foremen. Some of the most costly bottlenecks can be eliminated by replacing old or inferior equipment at key points in the production system. Whenever a machine causes trouble for the operator, requires constant repair, or attention, or is not producing enough work to pay its way, the foreman should feel free to recommend replacement.

Adhering to budget limitations is not the easiest part of a foreman's job, but by keeping a watchful eye on overhead expenses, he can stay within a well-planned budget. Unfortunately, many foremen tend to regard budgets as symbols which may arouse fear, resentment, hostility, and aggression on the part of employees toward the company, leading in turn to decreased production. As one supervisor put it, "I'm awfully strong against the figures. I keep away from showing them to my workers. They are doing a good job, trying their best. If I put on the heat with this budget stuff, they'll blow their tops."

Management can help in this respect by seeing that all budgets are flexible, and do not place too much emphasis on the end result, but consider the total picture.

QUALITY CONTROL

Enforcing quality control falls mostly to supervision. In general, the quality of production must be constantly stressed to the personnel. Top grade products are necessary if the company name is to retain integrity and dignity. The touchier the production job, the more supervision must seek quality as well as quantity. Materials are too expensive to be turned into scrap—they must be properly stored, handled and worked. Employees will remain more aware of scrap prevention if they are instructed to notify their foreman whenever a faulty piece of work is turned out, and if only author-

ized persons are permitted to scrap materials, parts or assemblies. It is also a good plan for supervisors to constantly check all along the line, ahead of final inspection, to see that good work is being turned out.

Campaigning aggressively for cost control will often do wonders. One executive, according to R. D. Bundy, author of "What Price Supervision," won real results from such a campaign. Part of the program was to have each operator individually turn bad parts upside down in the end of the tray. The effect was noticeable immediately, because the operator could see the amount of scrap produced. The operators were on piecework, and were paid for good pieces only. Scrap was a definite loss to them, and when the defective parts began to accumulate where they could see them, they began to use more care. This worked so well that the inspection force was reduced from twelve to three.

One of the foreman's strongest selling points in the program was to call attention to the time each operator saved when no defective parts came from the preceding operation. Before the campaign started, the most common complaint from the operators was, "I can't make out on piecework with all the junk I am getting." No exception to the truth of this statement had ever been taken; it was self evident to everyone. But under the changed procedure, the reverse was equally true: "If I get good work, I can increase my production with less effort." The result was that the scrap percentage was reduced from 12 to 1½ per cent. Operators not only increased their production through scrap reduction, but they also did the work easier, which increased their job interest and morale.

OVERCOMING EMPLOYEE OPPOSITION

Launching a campaign to cut costs is one thing, but making it pay off is another. One of the troubles the foreman may encounter, and should be well briefed on, is opposition from employees. Many tend to regard such programs as speed-up plans. To achieve cooperation, such notions must be dispelled. Experience proves that workers will react constructively if their own ideas on how to improve production are solicited and considered. Foremen who appeal for suggestions must affirm that they want them for only one reason—to produce more and better units at less cost, but without hurting the employees. Whether the suggestion system is formal or informal, it works best where there is a sound, pleasant relationship between foremen and the employees.

Promoting employees morale is a vital function of supervision. The foreman must be able to interpret and present management's policies in terms and language that will be understood and accepted by employees. He must also make it his business to have a man-to-man understanding with his subordinates. On one hand, he must gain their confidence by letting them know he is sincerely interested in them and in their problems, and will help them as much as he can. On the other hand, he must make it clear that his job is to get out production, and that if they are to keep his respect, they must be willing to "get in there and punch."

Whether the rank-and-file worker regards his work with interest and enthusiasm, or whether he "puts in eight hours," hinges squarely on the foreman, and shows up plainly on the production charts and profit-and-loss statements.

To eliminate losses from lateness, early quitting, idleness, etc., and to instill in employees a spirit of cooperation and teamwork, requires plenty of patience and tact. But it must be done, because men and women respond to the environment around them. Supervision which supplies an environment that encourages and stimulates ability to its full extent drives men toward record achievement. If the foreman speaks softly, uses praise instead of criticism to get results, and shows his employees equal courtesy, opportunity and fairness, he will find his job easier and his results what they should be.

These methods have stood the test of actual use in plants throughout the country. Foremen who try them will find them "just what the doctor ordered"—a specific for lowering inflationary fevers by reducing the costs which are within their power to control.

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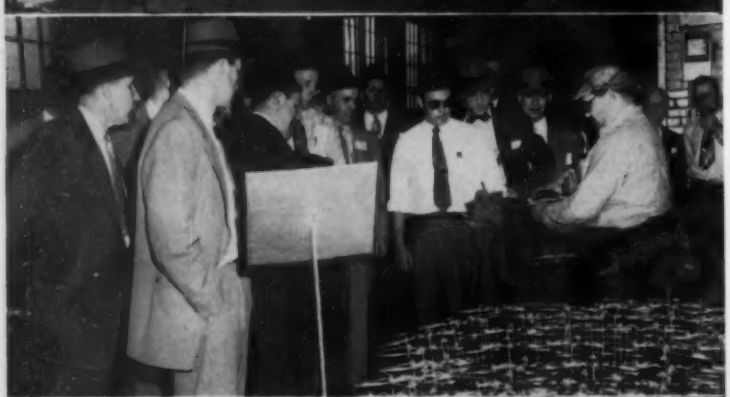


A. J. Fisher, general manager of Bethlehem's Johnstown plant, gets together with J. L. Young, AISE president in a before-dinner chat at Sunnehanna Country Club. Mr. Fisher addressed members and guests of the Pittsburgh section of the Association following an inspection trip of the Johnstown works.

INSPECTION TRIP

OF

BETHLEHEM STEEL COMPANY

JOHNSTOWN PLANT

SPONSORED BY

PITTSBURGH DISTRICT SECTION AISE

MAY 4, 1953

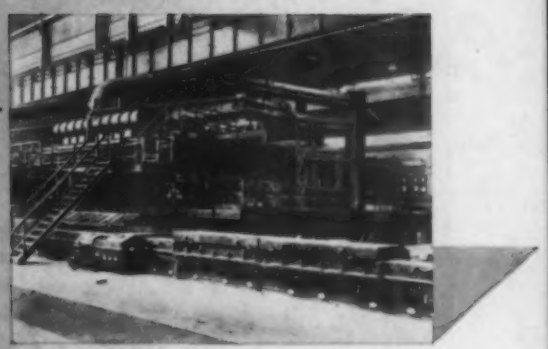
Bethlehem Steel Co.'s Johnstown, Penna., plant, celebrating its 100th anniversary, was the scene of an inspection trip held by the Pittsburgh district section of the AISE, May 4th.

Over 400 members and guests toured the various divisions of the sprawling plant that stretches some twelve miles along the banks of the Conemaugh River. They were duly impressed with the modern facilities — made possible by a far-sighted expansion program — that make the century-old Johnstown works a leading producer in the steel industry.

Many, however, were most impressed with the unique activities of the specialty shops which turn out items not usually associated with the production of basic steel. On display in the forge and axle department, for example, was a section of fabricated steel sewage pipe. At the versatile rod and wire mill a wire fence machine drew a great many interested onlookers, while the assembly of the four-piece spindle, on which barbed-wire is rolled, fascinated many. At the Gautier division, the highway specialty shop featured a cut-away section of concrete with steel reinforcements. Other specialty items included wheels and axles, complete railroad freight cars, miscellaneous track accessories, fence posts, nails, and fabricated material for building construction.

Following the trip, dinner was served at Sunnehanna Country Club, where A. J. Fisher, general manager of the Johnstown plant, reviewed the progress made in the 100 years since the plant founding, and paid tribute to the men responsible for its growth.

LOOK TO RUST FOR FURNACE EFFICIENCY



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Rockbestos A.V.C. (AVA) operates through temperatures up to 230°F . . . resists steam, grease or corrosive fumes . . . even withstands flames.

The Rockbestos A.V.C. construction special hi-dielectric tapes and sealed by felted asbestos walls . . . provide more years dependable service . . . cut maintenance and operating costs to the bone.

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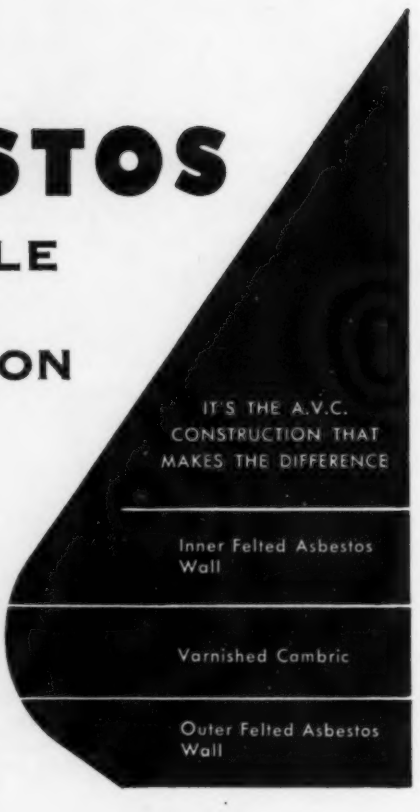
IT'S THE A.V.C. CONSTRUCTION THAT MAKES THE DIFFERENCE
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Varnished Cambric
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ADJUSTING SPECIFIC GRAVITY OF REPAIRED BATTERIES

▲ IT is often necessary to adjust the specific gravity of industrial storage batteries which have been repaired because of leaks, spills, or overflowing. In such cases, the electrolyte is lost. Acid must be added to the battery to restore it to the correct specific gravity. Follow these recommendations by Gould-National Batteries, Inc., for best results.

Only sulphuric acid should be used and only sulphuric acid specified "for storage batteries." Storage battery acid can be obtained from any of the larger manufacturers of sulphuric acid.

If the decrease from normal specific gravity is slight—15 points or less—acid of 1.300 sp gr may be added instead of water for several additions over a period of time until the battery is back to the proper gravity.

When you wish to raise gravity more than 15 points, remove some of the electrolyte from the cell and replace it with 1.400 sp gr acid. After the normal charge, keep the cell on charge at the finishing rate while adjusting the acid, so that the evolved gas will stir and mix the acid with the remaining electrolyte. One-half to one-hour charge is required to mix the acid thoroughly with the liquid already in the cell.

If the fully charged sp gr of a cell is found to be above normal, adjust downward by removing some of the electrolyte and replacing it with pure water. Guard against specific gravities above 1.310 because the battery may be injured.

Here are some tips that will help in mixing and adding acid properly.

TABLE I

Electrolyte Required by Different Types and Capacities of Batteries

Type of Cell	Amp hr capacity per Positive Plate	Lb per positive plate 1.280 Sp Gr
KMZ	34	1.6
KTZ	40	1.6
XVLZ	40	1.6
KHZ	55	2.3
XLZ	55	2.3
KRZ	100	5.0
XRZ	100	5.0

Use this table to determine the pounds of 1.280 sp gr electrolyte required per cell. For instance if you have cells with 40 amp hr capacity per positive plate, multiply the numbers of positive plates in the cell by 1.6 to arrive at the pounds of electrolyte at 1.280 sp gr required per cell (1.280 sp gr acid weighs 10.7 lb gallon) (1.835 sp gr acid weighs 15.3 lb per gallon.)

The amount of 1.280 sp gr electrolyte required per cell can be determined by multiplying the number of positive plates in the cell by the constant given in Table I.

Sulphuric acid is usually sold in either 1.835 or 1.400 sp gr concentration for storage battery use. To change the sp gr to another value, it is necessary to mix it with pure water. Always add the acid to the water and not water to acid when mixing. Add the acid in small amounts stirring constantly. Heat usually develops when mixing acid with water. The mixture should be cooled to 100 F or below before adding to the cell. Pouring a hot mixture in a cell may injure it.

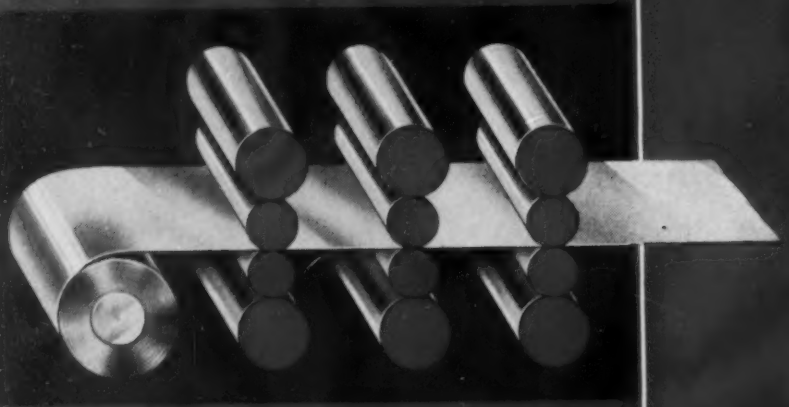
Table II will be useful in mixing acid with water to obtain electrolyte of the desired sp gr.

TABLE II

Water-Acid Mixtures Required to Obtain Electrolyte of Various Specific Gravities

When mixing by volume using 1.835 acid		Specific gravity desired 77 F	When mixing by volume using 1.400 acid	
Parts water required	to Part acid required		Parts water required	to Part acid required
1.78	1	1.375	0.75	1
1.86	1	1.365	0.11	1
1.94	1	1.355	0.14	1
1.975	1	1.350	0.16	1
2.08	1	1.340	0.20	1
2.17	1	1.330	0.24	1
2.22	1	1.325	0.27	1
2.33	1	1.315	0.31	1
2.42	1	1.310	0.33	1
2.52	1	1.300	0.38	1
2.65	1	1.290	0.43	1
2.70	1	1.285	0.46	1
2.79	1	1.280	0.49	1
2.84	1	1.275	0.53	1
2.92	1	1.270	0.56	1
3.10	1	1.260	0.63	1
3.18	1	1.255	0.67	1
3.26	1	1.250	0.70	1
3.38	1	1.245	0.74	1
3.46	1	1.240	0.78	1
3.67	1	1.230	0.85	1
3.80	1	1.225	0.905	1
3.91	1	1.220	0.96	1
4.03	1	1.215	1.00	1
4.15	1	1.210	1.05	1
4.26	1	1.205	1.11	1
4.43	1	1.200	1.16	1

To use this table, find the specific gravity desired in center column. If you have ordered acid of 1.835 sp gr, use figures on the left. Use right hand columns for 1.400 sp gr acid.



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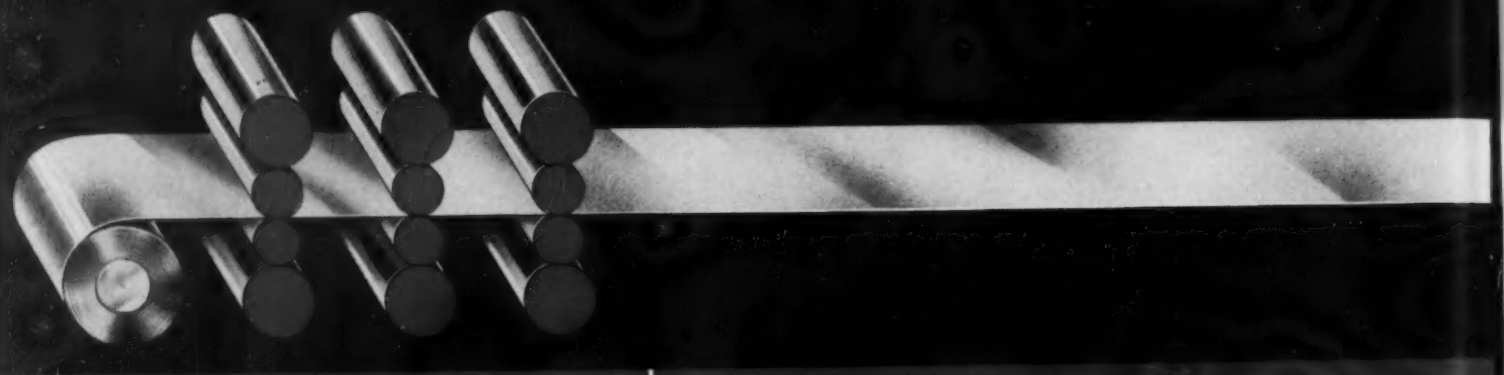

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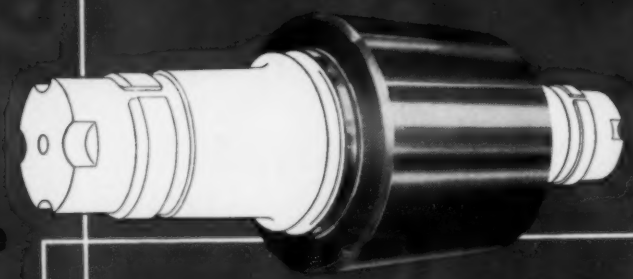
Lower Overall Costs



And, there are good reasons why the records show exceptional service resulting from the use of Heppenstall Sleeves. It's because they're "custom-bilt" . . . normalized, annealed, heat treated, and tempered to exact specifications. The results:

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ARMCO STARTS OPERATION ON NEW 80-IN. HOT STRIP MILL AT ITS ASHLAND PLANT

Figure 1 — Newly completed facilities at the Ashland, Kentucky Division of Armco Steel Corp. are outlined in this aerial view. A building almost a half-mile long houses the new hot strip mill, and side buildings are for accessory equipment. New office buildings and a gatehouse have also been completed.

▲ A huge new $40,000,000, 80-in. hot strip mill was officially placed in service on May 20, 1953 at Armco Steel Corp.'s Ashland, Ky., plant, thus both the newest and the oldest continuous steel rolling mills in the world are located in the same plant. The mill is housed in a building almost a half-mile long, and has a capacity of 150,000 tons of finished sheet steel a month.

Just 30 years ago, Armco developed the continuous rolling process at its Ashland plant, and the basic facilities of that original mill are still in operation, although the old mill will soon discontinue operation.

Armco's overall expansion program at its Ashland plant will cost $47,000,000. Although the major portion of the program has now been completed, construction is continuing on facilities for processing light gage steel. These include a continuous pickling line for removing oxides that form on the steel during rolling; a cold reversing mill which rolls strips of cold steel into even thinner gages; and light and heavy gage Zincgrip lines to coat strip steel with zinc in a continuous process.

It is expected that these additional facilities will be completed in about a year, giving the Ashland Division of Armco the most modern such equipment in the world.

80-IN. HOT STRIP MILL

The 80-in. hot strip mill is a completely integrated operation housed in a building almost a half-mile long. The mill is designed to roll 10-ton ingots into sheet at about 1800 fpm. Capacity is 150,000 tons of finished steel a month.

Stripper shed and soaking pits — In this section, the mold, is stripped from the ingot. The ingots are then placed in the soaking pits until they reach about 2200 F. There are 20 pits, holding 10 ingots each, with fully automatic gas and air controls. Depending upon its original temperature, the ingot remains in the pit for 2 to 8 hours. An electronic control system allows the crane operator to open and close the covers of the pits. The ingot buggy which carries the hot ingot to the slabbing mill, can also be controlled by the crane operator from his air-conditioned cab. A fully integrated intercommunication system connects the crane operator with the other major units of the mill.

Slabbing mill — The slabbing mill, a single stand mill of 2-high design, reduces the ingot which may be as large as 22 × 57 × 72 in. and weighs 24,000 lb, to a slab about 4 in. thick, 75 in. wide, and 25 ft long. Rolls measure 45 × 100 in. and are pow-

Figure 2 — The soaking pits at the new hot strip mill consist of 20 pits, holding 10 ingots each.

Figure 3 — Slabbing mill is powered by motors totaling 9000 hp. The vertical edger is shown at left. The machinery is operated from a glass-enclosed control booth out of sight behind the mill.

ered by a 7000-hp motor housed in a fully air-conditioned motor room. The width of the slab is controlled by the vertical edger which is powered by a 2000-hp motor and operated in conjunction with the slabbing mill.

Slab processing — The slab is then conveyed to a high-level table where it may be "scarfed" by oxy-acetylene jets to remove surface imperfections. Uneven ends of the slab are sheared off and the slab is placed in one of two slab furnaces which act as a bank or reserve between the slabbing and roughing units.

Roughing mill — After leaving the slab furnace, the steel travels in a straight line through the remaining rolling operations. The roughing mill is made up of four stands, two stands of 2-high mills and two 4-high mills. The 2-high stands have work rolls 40-in. in diameter and 80-in. long. The 4-high stands have 27-in. diam work rolls 80-in. long with back-up rolls 54-in. in diam and 80-in. long. These mills are driven by one 3000-hp motor and three 5000-hp motors, all housed in an air-conditioned motor room. The roughing mill reduces the slab to a bar about 0.6 in. thick and about 100 ft long.

Figure 4 — The six finishing stands of Armco's new hot strip mill at the Ashland, Ky. Division are arranged in close succession. The strip leaves the final stand at a speed of about 1800 fpm.

Bar shear — This shear, located directly in front of the finishing mill, may be operated as either a stationary or flying shear. It is used primarily to give the front edge of the bar strips a square end before they enter the finishing mill, but it may also be used to cut the bar strips into smaller sections.

Finishing mill — The finishing mill is made up of six stands of 4-high mills. The back-up rolls of each are 54-in. in diam and 80-in. long; the work rolls are 27-in. in diam and 80-in. long. These mills are powered by one 4000-hp motor, one 3500-hp motor, and four 4500-hp motors. The finished strip emerges from the last stand at a speed of about 1800 fpm and may be over 1000 ft long. Its thickness is continuously checked by an X-ray gage.

Flying strip shear — The flying strip shear is positioned directly behind the finishing mills. It is designed to cut the strip into lengths of 15 to 30 ft as it moves at full speed. The length of the cut sections will be accurate within ¼ of 1 per cent.

Finishing mill runout table — The runout table is 285 ft long. It provides space for the strip ahead of the coilers and the piler and is also used to control the temperature of the finished strip. The temperature control system can utilize up to 16,000 gpm of water, and is the largest and most versatile such system in the steel industry.

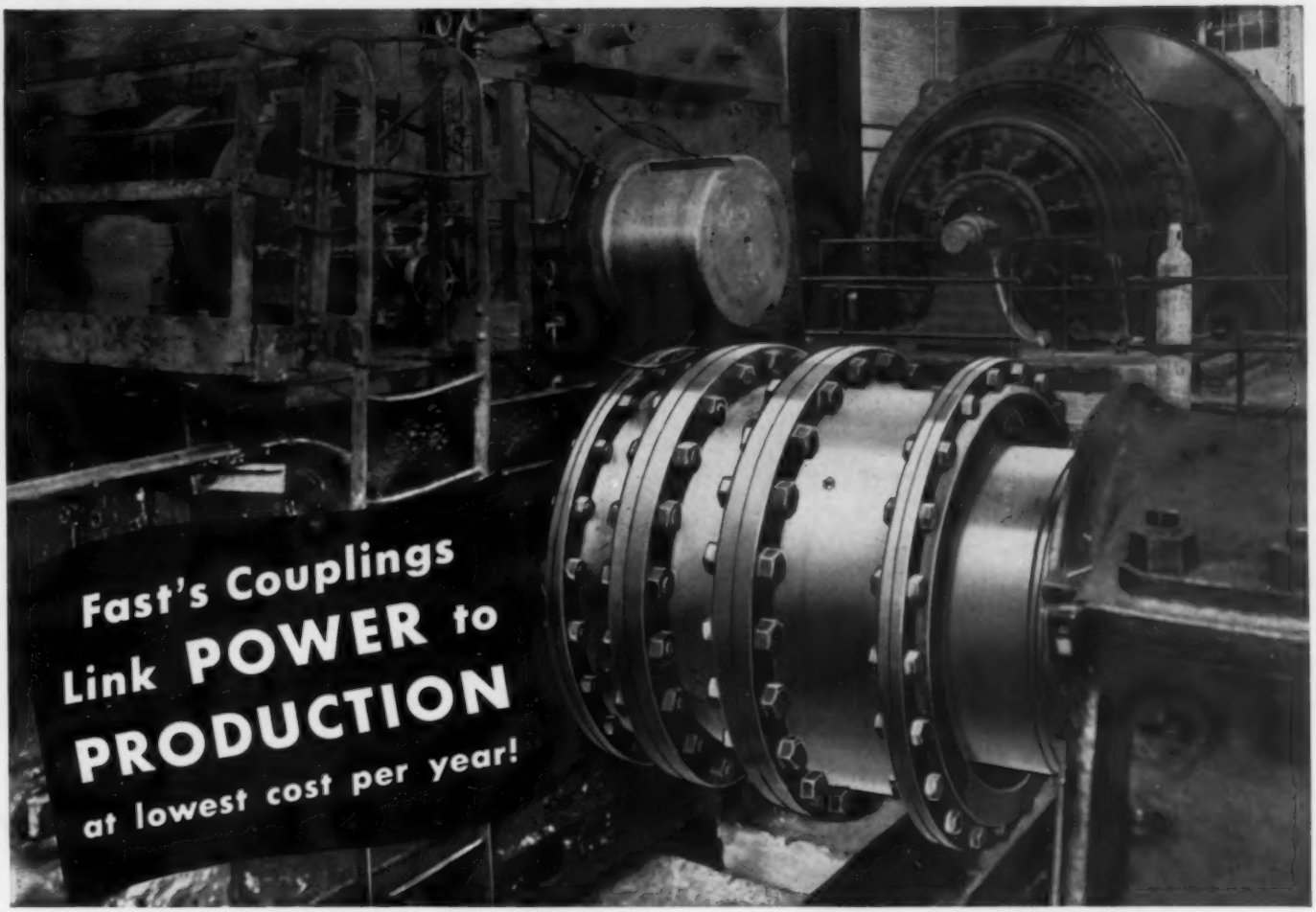
Strip coilers — The two strip coilers, operated alternately, wind the finished hot strip into tight coils. The coils are then banded, weighed and placed on a pallet-conveyor for transfer to the processing units of the plant.

Sheet piler — The sheet piler is used to stack the hot sheets cut by the flying shear. Stacks of the sheets are transferred to the processing units of the plants by a conveyor table.

SUMMARY

Although this brief description has covered the separate units of the hot strip mill, the mill should properly be considered as a unit in itself. Each operation must be timed in relation to the entire train of product flow. This system, which keeps the steel hot all the way through the rolling process from soaking pits to coilers, is unusual in the steel industry. It requires an organization trained for teamwork and full cooperation.

To control timing, the entire mill is linked with a two-way intercommunication system. Modern electronic control systems are housed in operating "pulpits" located at high levels throughout the mill building to provide full view of the operations.



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BROOKS OIL EXPANDS PLANT CAPACITY

▲ A modernization program designed to increase operating capacity of the Brooks Oil Co. plant by approximately 20 per cent has just been completed. With the new grease kettles and other processing equipment in production, the plant has a daily capacity of 900 drums of industrial lubricants. The expansion provides an additional 20,000 square feet of floor space. At present, two-thirds of the plant is devoted to production of Leadolene and kindred products, and one-third to Klingfast and forging compounds.

Brooks is exclusively a producer of industrial greases, and the increased capacity to 900 drums per day will now enable the company to keep pace with increasing demands. All of the company's research, engineering and sales efforts are devoted to one thing — the production of industrial lubricants.

Now in its 77th year, The Brooks Oil Co. was established in Cleveland on a relatively small scale in 1876. Since then development has been steady. The company today is an international organization with plants and warehouses in Cleveland, Ohio and Hamilton, Ontario; a warehouse and office at Santiago de Cuba; district sales offices in eleven cities in the United States and Canada; and warehouses in six American cities. The company is equipped and located to serve 85 per cent of the steel plants in the United States and Canada. In addition, through The Brooks Oil International Co., industries in France, Italy, Belgium, Switzerland, Denmark, Sweden, Norway, Finland, India and Japan are being served.

Figure 1 — Henry W. Winkler, vice president in charge of research for Brooks Oil Co., (extreme right) discusses quality control of lubricants used in wire rope. Emphasis on quality through laboratory research and control is one of the company's policies, and a well equipped laboratory is located at the Cleveland plant.

The company is unique in that it is the only one of its type operating with trained engineers who can recommend lubricants "on the spot," thereby solving lubricating problems in the customer's plant. All Brooks sales representatives are trained engineers.

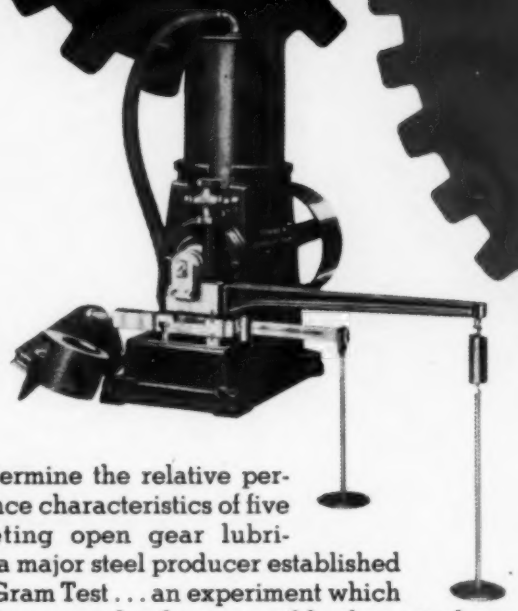
The company specializes in lead-based lubricants. Among them are Klingfast and Leadolene, which have film strengths of up to 50,000 psi. They benefit users in two ways: (1) through extended equipment life made possible by superior lubrication, and (2) through reduced lubrication consumption.

The company is able to offer several unusual services to its customers. Every batch of lubricant is thoroughly tested before it is shipped from the plant. Another special service is provided to operators of circulating systems. At regular intervals the customer draws off a sample of the lubricant and sends it in an "easy-to-mail" kit to the Brooks laboratory. A thorough analysis is made to determine pH-ilm strength, state of oxidation, cleanliness and other factors. From this analysis certain mechanical failures of the system can be corrected.

INDEPENDENTLY CONDUCTED

4-GRAM TEST

—PROVES LEADOLENE KLINGFAST BEST FOR LUBRICATING OPEN GEARS



To determine the relative performance characteristics of five competing open gear lubricants, a major steel producer established the 4-Gram Test . . . an experiment which reproduces as closely as possible the actual service conditions encountered in open gear and sleeve bearing lubrication.

In this test the Timken Testing Machine, recognized as standard equipment for testing lubricants, was modified slightly to reproduce more precisely actual service conditions. The hardened and ground steel block and cup, indicated at right, normally is under constant lubrication. However, in the 4-Gram Test the flow of lubrication was cut off and 4 grams of the lubricant being tested were applied at room temperature. The machine then was set in motion and watched closely for signs of scoring.

Five lubricants, all accepted in industry as "good quality," were tested. *Results of the test showed that LEADOLENE KLINGFAST gave over 3½ times the service of the next best lubricant and up to 6 times the service of the other lubricants tested.*

Since open gears are lubricated periodically and not constantly, the pH-ilm must have lasting characteristics. Thus, this test is truly representative of actual field operation tests for open gears. The enduring action together with extremely high pH-ilm strength guarantee the machine actual lubrication and protection.

In testing . . . and more important, in actual service . . . LEADOLENE KLINGFAST regularly gives comparable performances. A product of 76 years of manufacturing experience, it is a lead-based lubricant with an "Indestructible pH-ilm," capable of withstanding pressures up to 50,000 psi. With LEADOLENE KLINGFAST you profit in two ways: from lowered lubrication costs due to less frequent application, and from greater service life from the machinery being lubricated.

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Results OF 4-GRAM TEST

LEADOLENE KLINGFAST	LUBRICANT "A"	LUBRICANT "B"	LUBRICANT "C"	LUBRICANT "D"
30 MINUTES without scoring or failing.	5 MINUTES A high grade compound scored at 5 minutes and failed in 12 minutes.	8 MINUTES A reputable lubricant of residual nature scored and failed in 8 minutes.	6 MINUTES A good lead compounded extreme pressure lubricant scored and failed in 6 minutes.	6 MINUTES A lead-compounded lubricant scored and failed in 6 minutes.

RECOMMENDED CARE AND HANDLING OF WIRE ROPE

By WALTER C. RICHARDS
Chief Engineer
A. Leschen & Sons Rope Co.
St. Louis, Mo.

▲ THE correct handling of a wire rope before use is very essential if best results in its use are to be obtained. Wire rope is often referred to as a machine and should be handled accordingly.

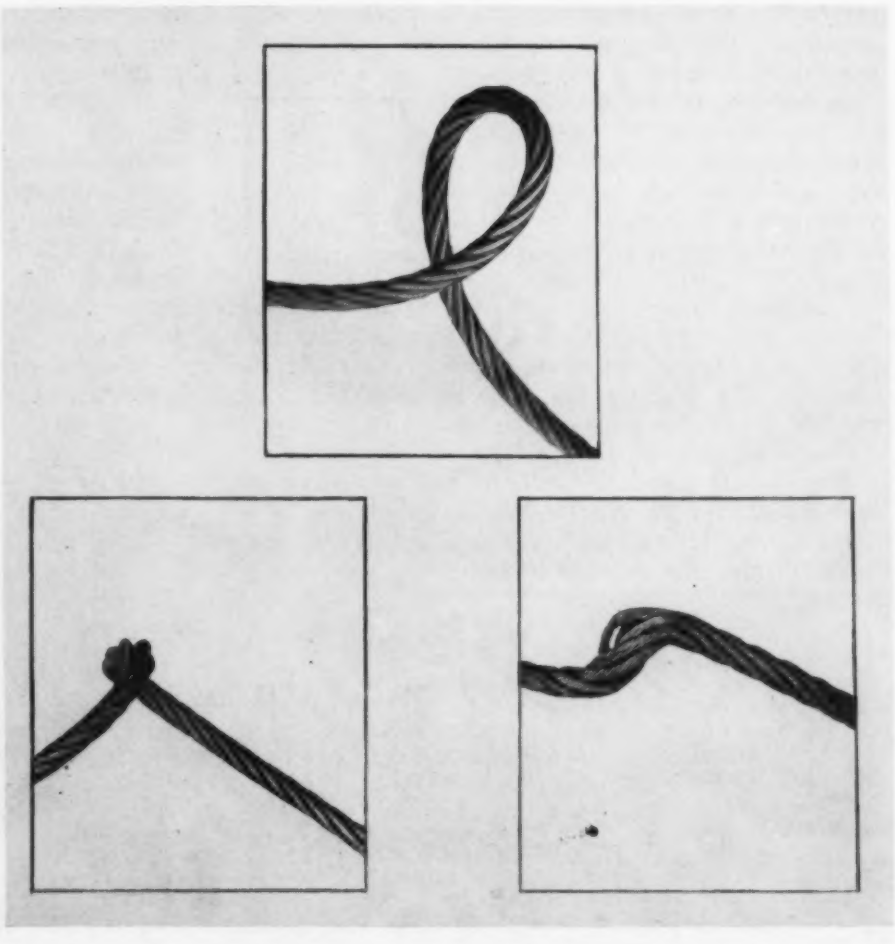
Wire rope arrives on the job either in a coil, or wound on a reel. It will no doubt reach its destination in a railroad car or truck. When unloading do not drop the reel onto the ground or platform. The heavy rope might shift its position or from its inertia alone cause the reel to collapse. This might damage the rope, or it could be damaged in the difficult operation of removal from a collapsed reel. If in a coil the rope might be bent enough to give it a permanent set. Do not roll reels or coils over very stony ground. The weight may cause sharp rocks to indent the rope. A bar used to roll a reel will do the same thing if it bears against the rope. Instead use the bar against the flange.

Storing — Reels and coils are generally stored for a period before installation. They should be placed under cover if possible or at least kept clean and dry and protected from the weather. Do not keep rope in a place that can be reached by acid fumes or other corrosive agents. If the rope is to remain in storage for some time, it is advisable to cover it with waterproof paper. As received, it is frequently factory covered with a "protector" which will preserve it for a long time. Otherwise, the outer layer should be covered with a good rope lubricant.

If used rope is put into storage, the same precautions should be taken to protect it from corrosion. In addition it should be thoroughly cleaned and given a coating of lubricant. It should be wound on a reel and not coiled loosely on the ground or floor. Do not pile heavy pieces of equipment on top of the rope.

Kinks and kinking — Careful handling will prevent kinks, which are

Figure 1 — A kink starts when the rope starts looping like this and the damage is done when the looping tightens as shown. Even if the wires are not badly damaged, the rope is out of shape, which means excess wear on the displaced strands. If the loop is thrown out at the start, kinks can be avoided.



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smallest cross-sectional area . . . conserves valuable installation space

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reduced installation time . . . simplified components, factory prefabrication

new joint design (*lower right*) . . . all joint ends identical, connection bolts face outward

interchangeable standard fittings . . . permit horizontal or vertical riser applications

users

vote these SQUARE D features tops:

low cost installation and maintenance . . . most accessible connections

totally enclosed . . . permanent safety construction, excludes dust

completely reuseable . . . rearrangement with the same components

EXCLUSIVE JOINT DESIGN

SQUARE D's **exclusive** joint design saves installation time and reduces maintenance cost. Joint ends are identical—unnecessary to select mating ends before positioning or hanging duct sections. Outward-facing, pre-installed bolts permit rapid assembly and easy maintenance.

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Figure 2 — Proper way to take wire rope from reel.

Figure 3 — The wrong way to take wire rope from a reel results in kinking.

almost impossible to remove and result in permanent damage to the rope. If a loop forms in slack rope, it should be thrown out at once, because a kink will develop if this loop is drawn tight. The strands are distorted and become permanently set in this position. Excess wear occurs and wires will fracture at this point. Even if the wires are not badly damaged, the rope is out of shape, which will mean excess wear on the displaced strands.

Unreeling and uncoiling — There is always danger of kinking a wire rope if it is improperly unreeled or uncoiled. A reel should be mounted on jacks or a turntable so it will revolve as the rope is pulled off. Sufficient tension should be applied to keep slack from accumulating, by means of a board acting as a brake against the reel flange. Or, the end of the rope may be held by a workman and the reel rolled along the ground.

When transferring rope from one reel to another be sure the rope is taken from the top of the full reel and wound over the top of the empty reel, or from the bottom of one reel to the underside of the second reel. Reverse bends are thus avoided.

Inspection of equipment — Before installation, the drums and sheaves on which the rope is to be used should be carefully examined. A new rope cannot be expected to give good service if the sheaves or drum are badly worn or damaged. If a sheave is out of round or has worn bearings, it will not run true and will damage the rope. Make sure the grooves are smooth and of full diameter. A sheave with a corrugated or pinching groove should be turned out or replaced.

Installing — It is good practice to wind the rope directly from the reel to the drum, being careful to see that the bends are made in the same direction as when transferring rope from one reel to another. Mount the reel with the axle parallel to the drum and keep it under tension to avoid accumulation of slack. On a smooth-faced drum a little more tension should be applied and the wraps kept close together without crowding. A right-lay rope spools best if wound from left to right over the top of the drum when viewed from the side opposite to that from which the rope is leading onto the drum. If underwound, the rope should lead from right to left.

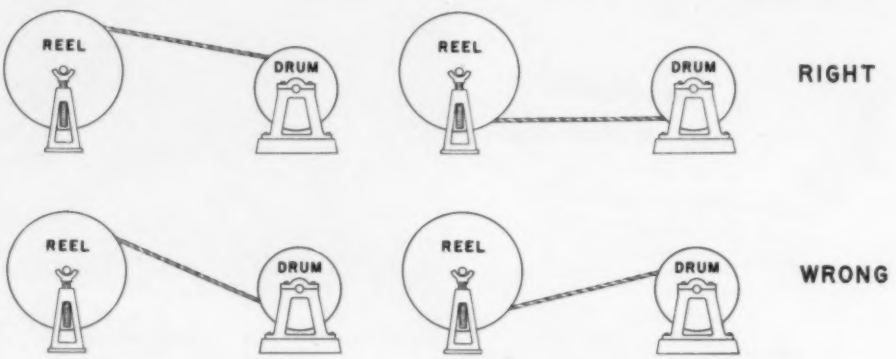

Figure 4 — Chart shows the "right" and "wrong" methods of installing wire rope from the reel to the drum.

Breaking in — It is very important, when starting to operate a moving rope, that the machine should be run for a while with no load, and for another period with a light load to enable the wires and strands to adjust themselves. By so doing the rope will have "set" itself to the working conditions and when full operation is reached, it will operate more safely and efficiently. The time spent in breaking in a wire rope will be more than regained by the extra service that will be obtained.

Working load — The ratio of the rated breaking strength to the normal working load is called the safety or design factor. In selecting the proper rope to use on any installation, it is necessary to employ an appropriate design factor. The estimated design factor should be greater if a careful calculation of all the forces acting upon the rope is not made.

It is impossible to set a figure to be used in all cases, as operating conditions are never the same. Such great variation exists that design factors may range from 3½ to 10. For estimating work of a general nature, a factor of 5 or 6 is frequently used.

The factors influencing the selection of the proper rope include the dead load, speed, acceleration and deceleration, length and weight of rope, diameter, number and arrangement of sheaves, size of drum, and fittings used. Also one must consider the effect of abrasion and corrosion, and the danger to life and property if the rope should fail.

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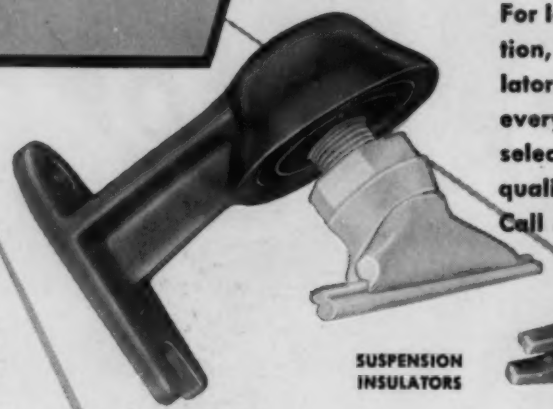

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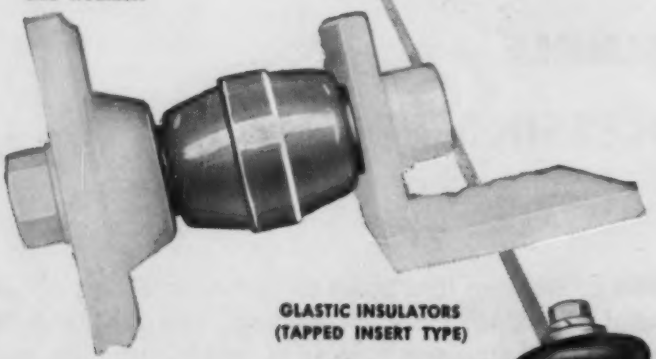

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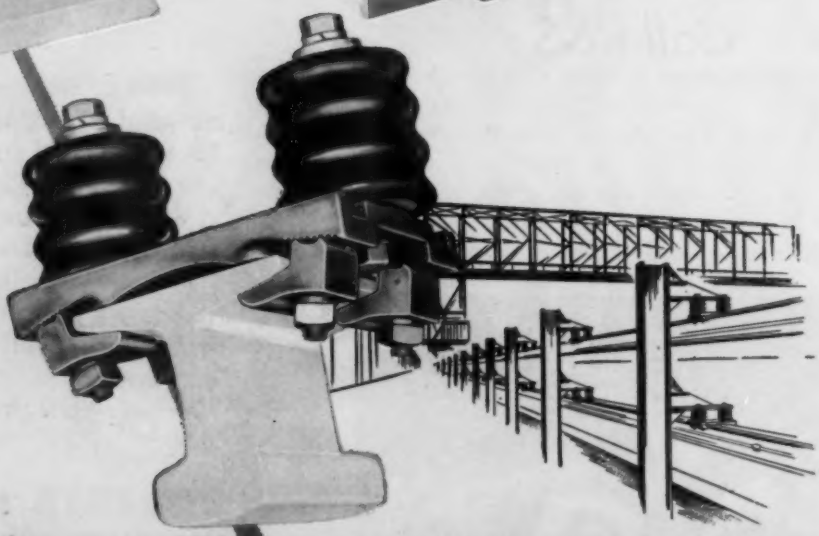

Basic units shown have great variety of application by use of proper fittings, selected from our Industrial Catalog. Write for illustrated folder.

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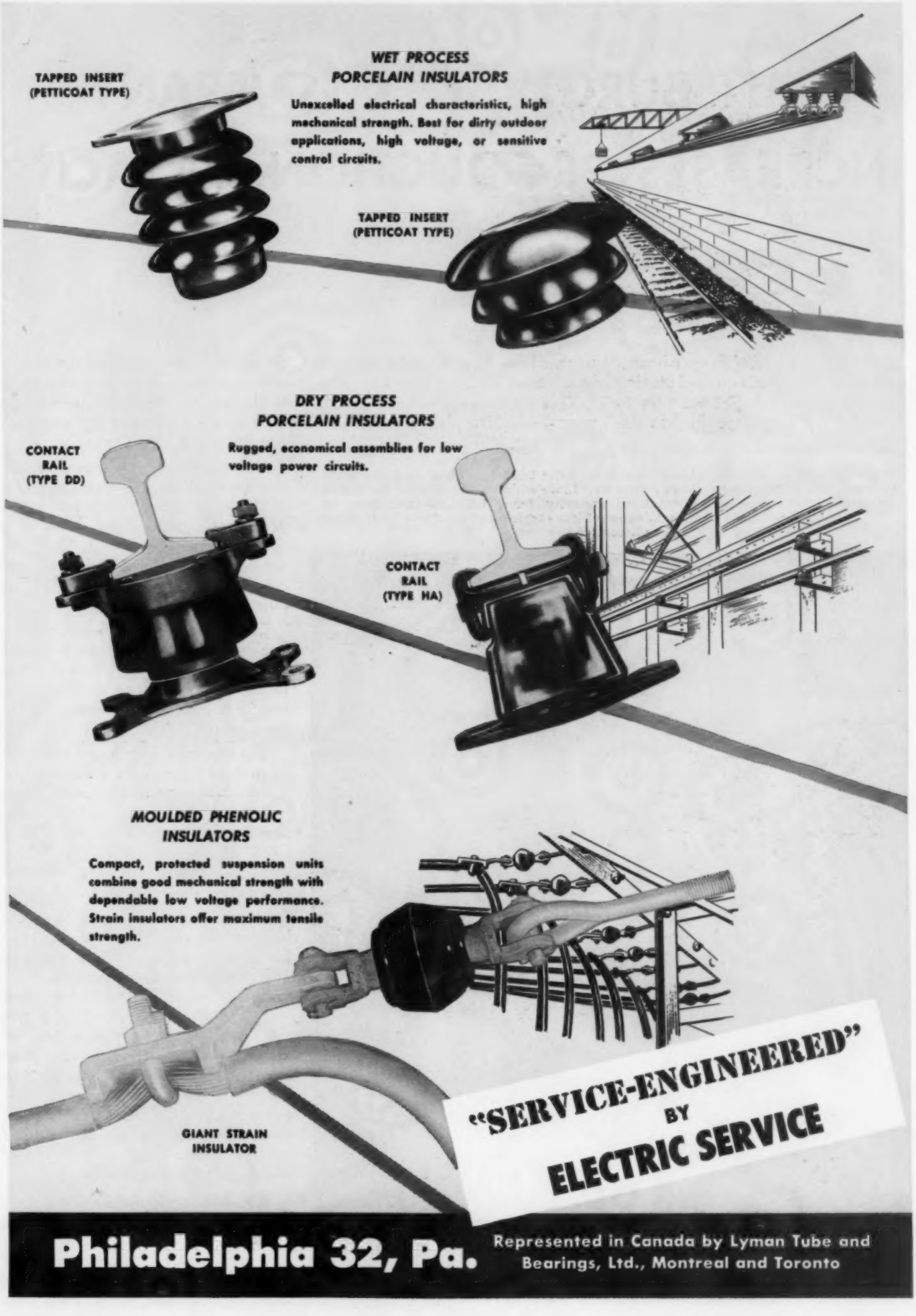
TAPPED INSERT (PETTICOAT TYPE)
WET PROCESS PORCELAIN INSULATORS
Unexcelled electrical characteristics, high mechanical strength. Best for dirty outdoor applications, high voltage, or sensitive control circuits.
TAPPED INSERT (PETTICOAT TYPE)
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CONTACT RAIL (TYPE DD)
Rugged, economical assemblies for low voltage power circuits.
CONTACT RAIL (TYPE HA)
MOULDED PHENOLIC INSULATORS
Compact, protected suspension units combine good mechanical strength with dependable low voltage performance. Strain insulators offer maximum tensile strength.
GIANT STRAIN INSULATOR
"SERVICE-ENGINEERED" BY ELECTRIC SERVICE
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Represented in Canada by Lyman Tube and Bearings, Ltd., Montreal and Toronto

PITTSBURGH STEEL COMPANY INCREASES PRODUCTION CAPACITY

▲ COMPLETION of an open hearth expansion that boosts its steel making capacity from 1,072,000 net tons to 1,560,000 net tons annually was announced on June 2, 1953 by Pittsburgh Steel Co.

This expansion advances the company from 14th place to 11th place among steel producers of the nation. The increase in capacity of 48 per cent is the largest expansion percentagewise to be completed by any steel company in recent years.

Figure 1 — Molten steel tapped from one of the twelve 250-ton capacity open hearths at Monessen, flows into a new ladle which will contain the entire heat. Expansion of steelmaking capacity from 1,072,000 net tons to 1,560,000 net tons annually advances Pittsburgh Steel Co. from 14th place to 11th place among steel producers of the nation.

Enlargement of the open hearths was accomplished by increasing each of the 12 open hearth furnaces at the Monessen works from 150-ton to 250-ton capacity per heat. The average individual open hearth furnace capacity in the industry is 135 net tons per heat.

Cost of Pittsburgh Steel Co.'s entire expansion at the ingot level will run to nearly $9-million. This amounts to the low cost of about $16.31 per ton for the increased capacity at the open hearth.

The new open hearths are equipped to make all grades of low, medium, high carbon and low alloy steel. They will supply highest quality ingots in these grades for Pittsburgh Steel Co.'s production of wire products, seamless tubular products, and flat rolled steel sheet and strip.

In addition to enlarging the open hearths, the charging floor was reinforced, the tapping pit floor was lowered three feet to accommodate 18 new 250-ton ladles, and three new 300-ton ladle cranes were installed in the tapping pit. Other new facilities include ladle stands, teeming platforms, slag pots increased from 275 to 325 cu ft capacity, large size ingot molds, an ingot stripper building and one stripper crane. Also being built are five blocks of soaking pits, two of which are now in operation.

The open hearth shop at Monessen is housed in three buildings, covering an area 1100 ft long by 230 ft wide. The open hearths are arranged in a row of long rectangular brick structures. Each furnace has a hearth area

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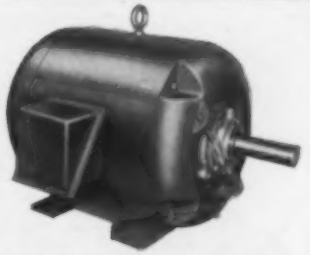
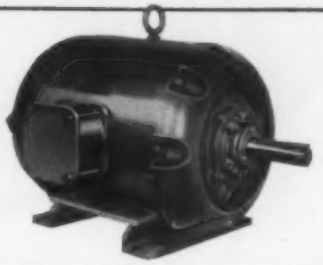
A Wagner engineer will be glad to help you select the correct motor for *your* specific application. Consult the nearest of our 32 branch offices, or write for Bulletin MU-185 for complete information.

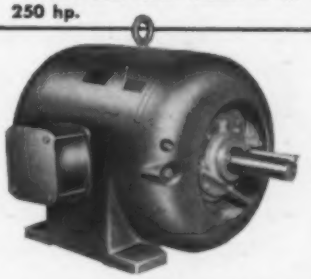


TYPE CP—Totally-enclosed Fan-cooled. Steel frame. 1 to 250 hp.

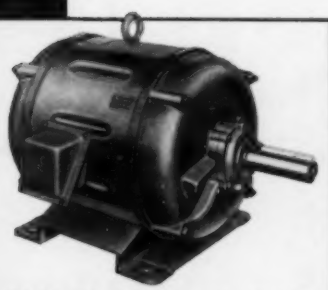


TYPE HP—Explosion-proof. Steel frame. 1 to 250 hp.

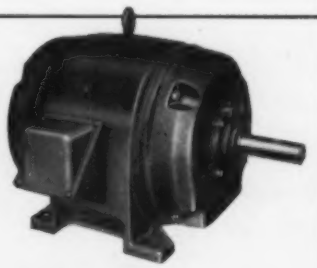
TYPE EP—Totally-enclosed Fan-cooled. Cast iron frame. 2 to 250 hp.



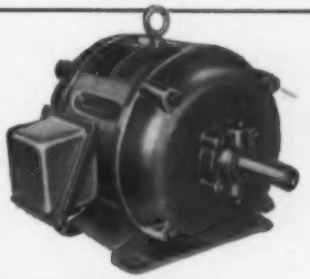
TYPE JP—Explosion-proof. Cast iron frame. 2 to 250 hp.



TYPE RP—Drip-proof. Steel frame. ⅛ to 400 hp.



TYPE XP—Splash-proof. Cast iron frame. ¾ to 200 hp.



TYPE TP—Totally-enclosed, non-ventilated. ¼ to 15 hp.

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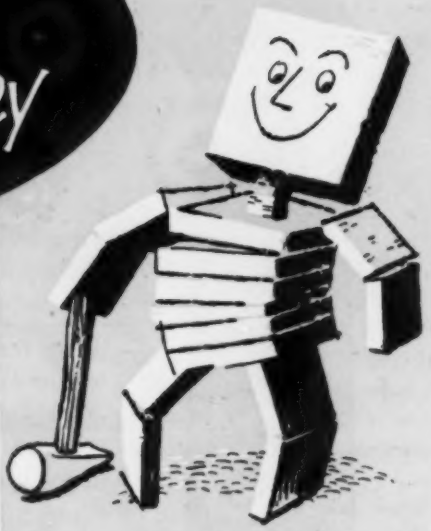

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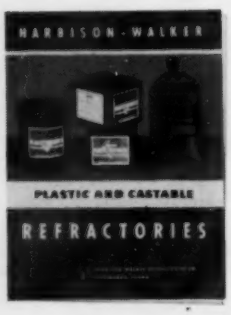
Complete data on all grades of Harbison-Walker Plastic Fire Brick and Castable Refractories are given in Bulletin EB-11.



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46 ft long by 15 ft wide, which will hold a bath 39 in. deep.

In preparing a heat, the furnaces are first charged with scrap steel, and with limestone flux, which will float out impurities in the metal. Molten iron is brought to the charging floor from the blast furnaces and charged into the furnaces. The ratio of molten iron to scrap will be about 50-50. The furnaces are fired with a combination of coke oven gas, oil, and pitch. Reversal occurs about every 15 minutes.

To increase the furnace heating capacity, division walls three feet thick have been removed from the checkerwork. Formerly, these walls served to divide the checkerwork so that one section was used to admit fuel, and the other section was used to preheat air. Under the new design, the fuel is admitted directly into the furnace, and the entire checkerwork is used to pre-heat the increased quantities of air required for the larger heats of steel. The heat of steel remains in the open hearth for an average of 12 hours.

All furnaces were rebuilt with a minimum loss of production. When furnaces went down for their normal rebuild, they were rebuilt to the larger size. Normal rebuild requires nearly two weeks. Rebuilding a furnace to the larger size required nearly a month. Each furnace, therefore, lost about two weeks production over a period of two-and-one-half years.

While the entire enlargement program under this schedule required nearly 30 months, the actual construction time on the furnaces was only 24 weeks.

SOAKING PITS

Completion of six new soaking pit furnaces for heating steel ingots at the Monessen, Penna. Works was also announced. The six furnaces, arranged in two blocks of three furnaces each, have a capacity to heat about 1350 net tons of high quality ingots every 24 hours.

Start of operations at the six furnaces marks completion of the first phase of a program to construct 15 new soaking pit furnaces at Monessen. Three more blocks of three furnaces each remain to be constructed. The entire installation, to cost over $3,500,000, will be one of the most modern batteries of soaking pit furnaces in the industry today.

Figure 2 — The new soaking pit furnaces at Pittsburgh Steel Co.'s Monessen works have a capacity to heat about 1350 net tons of high quality steel ingots every 24 hours.

The new completed unit is 51 ft wide, 88 ft long, and 27 ft high from foundations to the top of the furnaces. It is supported by steel piling that go down 45 to 53 ft below foundation level.

The outside shell is of steel. The interior is lined with silica brick. Each of the six furnaces located in the top of the unit is 13 ft wide by 16 ft long and 11 ft deep, and will hold 75 to 100 tons of steel ingots.

Ingots charged into these furnaces range in size from 6 to 16 net tons. They are soaked in the heat of the furnace for an average of five hours, becoming uniformly heated to about 2400 F and are rolled on Monessen's new blooming-slabbing mill into blooms, slabs, and billets for further processing.

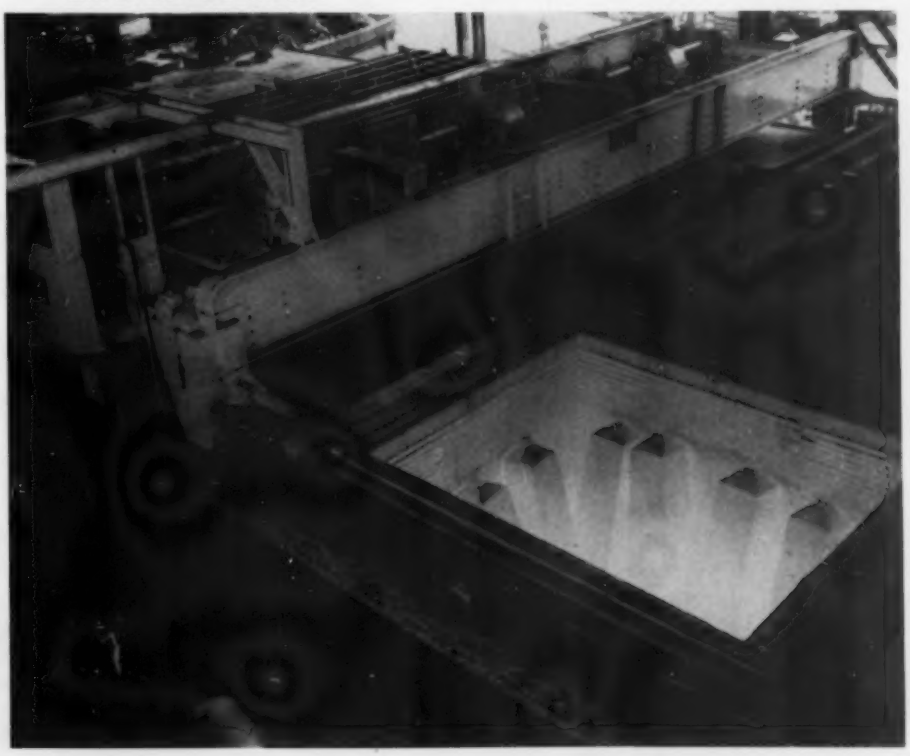
Each furnace has a 30-ton cover, which is moved on and off the furnaces by a pit cover carriage, which spans the entire unit and rides on rails at both ends. Ingots are charged into the furnaces and transferred from the furnaces by two 30-ton pit cranes.

Built by Amsler-Morton Corp., the two blocks are center-fired recuperative pits, designed for continuous firing to maintain constant temperature. They are equipped with fully automatic controls to assure efficiency, quality and uniformity.

Furnace design provides for heating with four types of fuel: coke oven gas, natural gas, mixed blast furnace and coke oven gas, and oil. Normally, the furnaces will operate on mixed gas.

When fired with natural gas, the furnaces have a maximum firing rate of 84,000 cu ft per hr, enough gas to supply the normal domestic requirements of over 1000 homes. To burn this amount of gas would require over seven tons of air per hour, equal in volume to 180,000 cu ft.

Figure 3 — The 30-ton cover carriage over the new soaking pits at Monessen, Penna., works of Pittsburgh Steel Co., lifts and rolls back the cover from one of the six furnaces.



Combustion gasses are discharged from the furnaces through two 125-ft stacks, each six ft in diameter, consisting of steel shell, which is brick lined.

Construction of the unit required 60 railroad carloads of steel, insulation and brick. About 42 carloads of high-quality brick were used.

The two new blocks of soaking pits have replaced old furnaces, which were dismantled. Excavation and foundation work was done by Rust Engineering Co.

One more old block of furnaces is now being dismantled. It will be replaced by two new blocks of three furnaces each, scheduled to be in operation later this year. The final new furnace of the five will be brought in early next year.

When completed, the five new furnaces and three others, already in operation, will have the capacity to handle the entire ingot output of the expanded open hearths at Monessen, about 1,560,000 net tons annually.

The new pits provide a vital link in the company's overall $62,800,000 expansion program, now nearing completion. The program includes: (1) an increase in blast furnace capacity by 12 per cent; (2) an increase in open hearth capacity by 48 per cent; (3) construction of five new soaking pits and installation of a new 66-in. high-lift blooming-slabbing mill, and (4) an increase in finishing facilities of 82 per cent.

First test runs were begun on May 31 on Pittsburgh Steel Co.'s new 66-in. semi-continuous, 4-high, hot mill for rolling steel sheets at Allenport, Pa. Following test runs, the mill will enter a break-in period before starting large scale commercial production.

Facilities for cold rolling steel sheet are now under construction adjacent to the hot mill, and are expected to begin operations later this year. With both mills producing, output of hot and cold rolled sheets will build up to 600,000 net tons per year.

Purposes of this expansion are to eliminate a deficiency in finishing facilities, develop greater diversification of products, and increase the company's earning potential.

AISE GRADUATE FELLOWSHIP AWARDED TO CARNEGIE TECH STUDENT

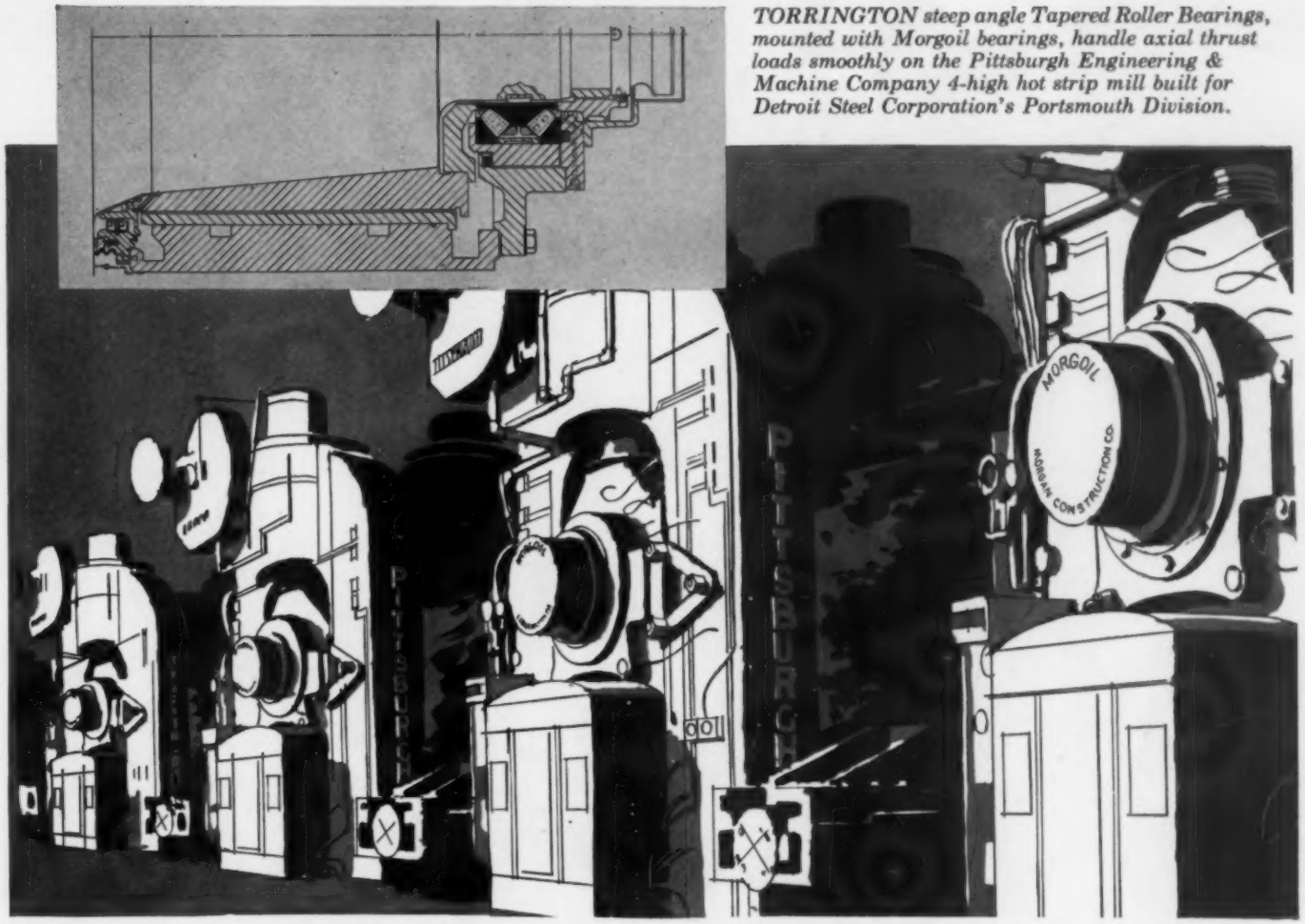
▲ The first of a proposed series of AISE fellowships for graduate study in the field of mechanical engineering was awarded to Clyde V. Stahle, Greensburg, Pa., for the academic year of 1953-1954. Initiated as part of the expanding research and educational program of the Association of Iron and Steel Engineers, the Fellowship is aimed at selecting and training outstanding men for engineering in the iron and steel industry.

A graduate of Carnegie Institute of Technology, Class of 1953, Mr. Stahle was selected from a group of candidates possessing outstanding technical ability and demonstrated capacity for leadership. He was graduated with honors, one of the top students in his class, and maintained a noteworthy scholastic record during his four years of study. During the summer vacation period he acquired working experience in the engineering department of the Elliott Co. plant at Jeannette, Pa.

CLYDE V. STAHLE

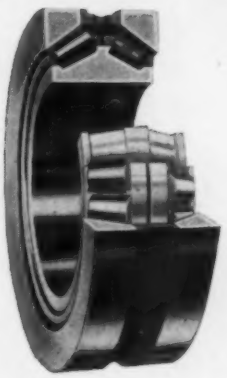
His accomplishments, however, were not limited to academic ventures, inasmuch as he earned his varsity letter as a four-year man in football, and was intra-mural heavyweight wrestling champion during his sophomore and senior years.

He will pursue his studies at the Carnegie school under the provisions of the Fellowship which includes a financial stipend, plus tuition and allowance for equipment, for study toward advanced degrees.



TORRINGTON steep angle Tapered Roller Bearings, mounted with Morgoil bearings, handle axial thrust loads smoothly on the Pittsburgh Engineering & Machine Company 4-high hot strip mill built for Detroit Steel Corporation's Portsmouth Division.

For peak efficiency and lower costs!



TORRINGTON Bearings are solving an increasing number of the problems posed by the heavier loads and higher speeds of today's steel mill equipment.

They carry the heavy thrust loads encountered in the high speed of the 4-high rolling mills. Engineered to meet these conditions, the steep angle construction guarantees maximum thrust capacity.

There are TORRINGTON Bearings to handle any combination of thrust and radial loads. They are available in a complete range of types, including cylindrical, tapered and spherical roller bearings.

Precision-ground races and rollers assure minimum friction, high capacity and long service—giving you maximum return for your bearing dollar.

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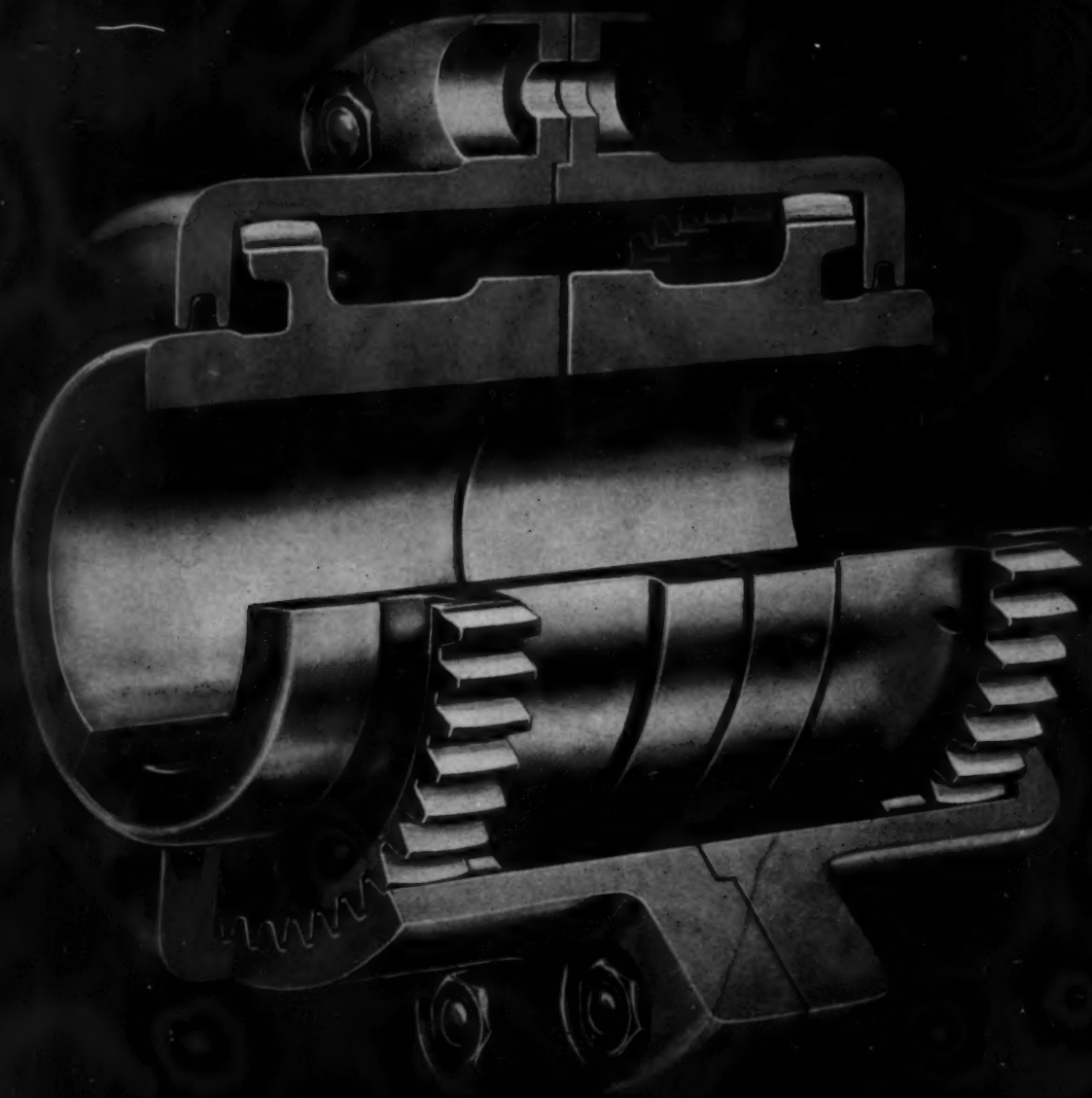

A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST

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The earliest Pyle-National floodlighting installations are still operating in excellent condition, with ***over a quarter of a century*** of efficient, economical service to their credit! Convincing proof of the value of quality, enclosed floodlights.

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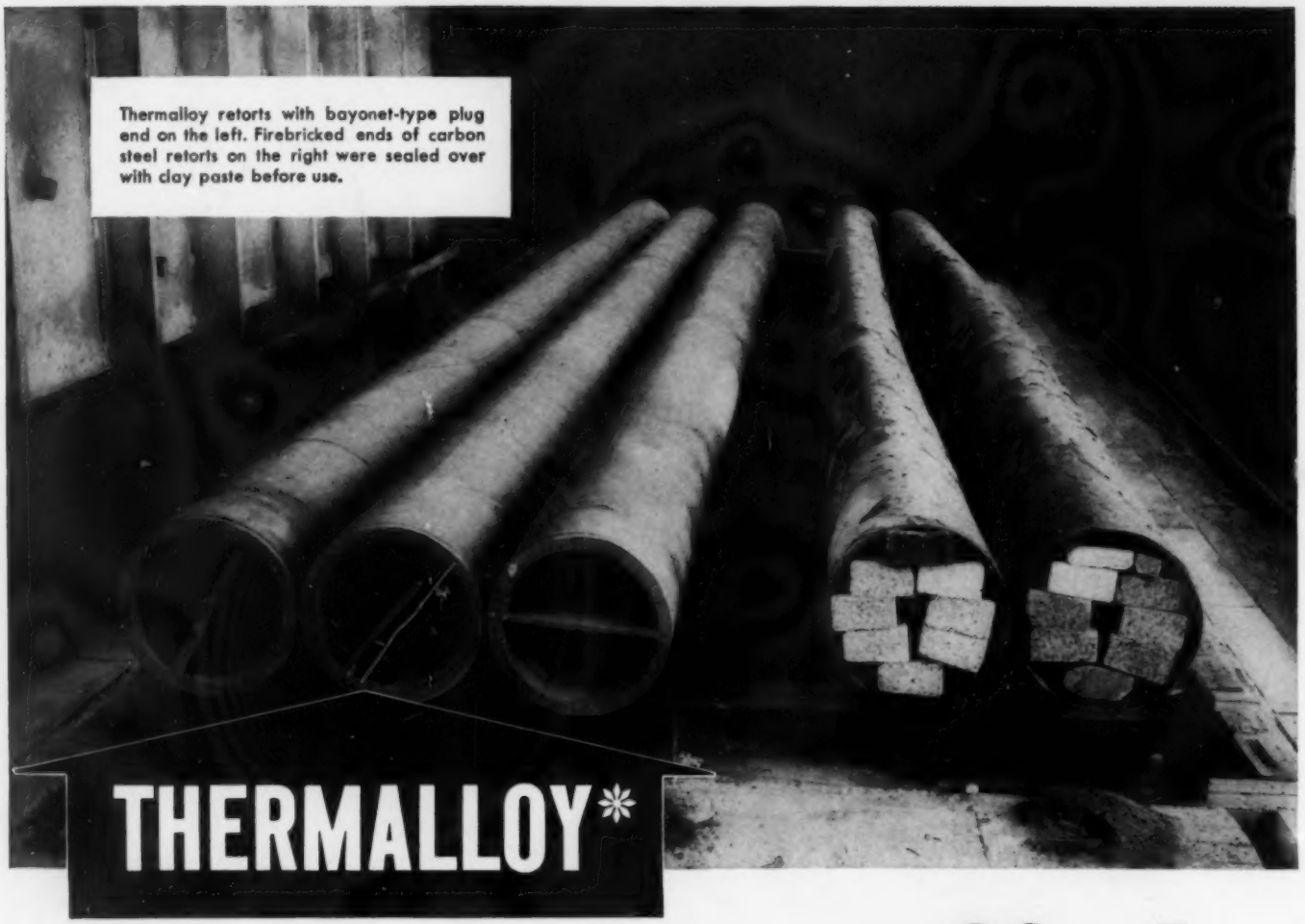

Thermalloy retorts with bayonet-type plug end on the left. Firebricked ends of carbon steel retorts on the right were sealed over with clay paste before use.

THERMALLOY* outlasts carbon steel retorts . . . 28 to 1

In a plant of a large eastern tool and specialty steel manufacturer, long, pipe-like retorts are used to anneal and heat-treat high-speed carbon and alloy steel bar stock in hood-type furnace equipment. Temperatures range up to 1650°F. during the annealing or heat-treating cycle that may last 30 hours.

Under these conditions, this manufacturer found that wrought carbon steel retorts scaled excessively and also distorted and flattened during operation . . . limiting service life to about 500 cycle hours. For the same operation, centrifugally cast Thermalloy retorts showed no measurable scale loss and maintained uniform wall thickness and shape. When last reported, Thermalloy retorts had been operating over 14,000 cycle hours and were still in perfect condition.

As the wrought carbon steel retorts became distorted, the plugs necessary to seal the open ends would not fit. Firebrick and a clay paste were used to seal the ends against infiltration of furnace gases. This made uniform annealing or heat-treating practically impossible. However, Thermalloy retorts, with plug ends designed by Electro-Alloys, afforded practically gas-tight seals and much greater ease of handling.

Today, this manufacturer is replacing all of the wrought carbon steel retorts with high heat-resistant Thermalloy retorts. Perhaps the same operating economy may interest you in Thermalloy retorts, furnace parts, trays, racks, pots or muffles. For full information, call in an Electro-Alloys engineer or write Electro-Alloys Division, 4007 Taylor Street, Elyria, Ohio.

*Reg. U. S. Pat. Off.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION
ELYRIA, OHIO

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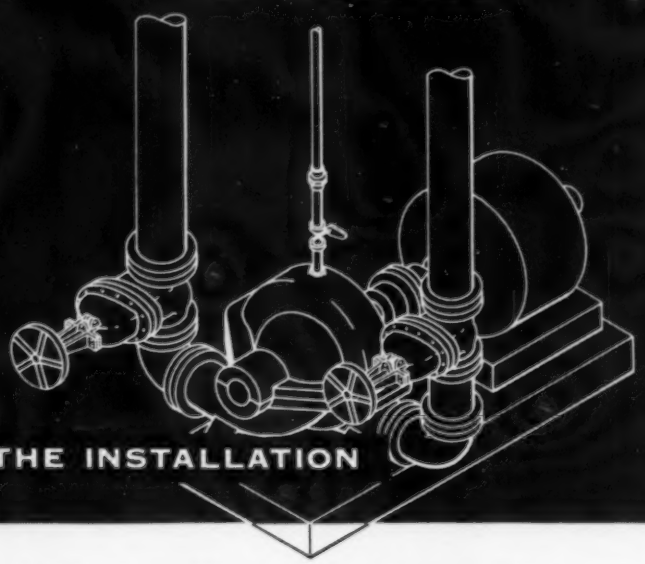
...on this Tough Pump Service, for instance



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Doing the job for 50 years

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SERVICE LIFE:
Installed 1903—Now on new pumps

OPERATING RESULTS:
No shutdowns for valve trouble

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At The Great Western Sugar Company, Longmont, Colorado, plant, with Crane Iron Body Wedge Gate Valves on suction and discharge lines of juice pumps.

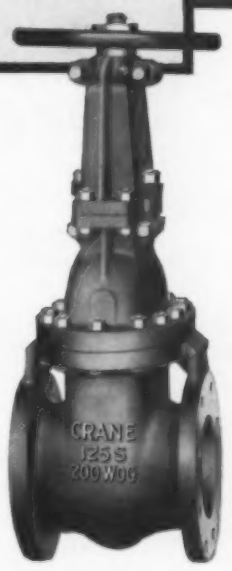
THE CASE HISTORY

Originally the Crane valves were installed on belt-driven pumps when the plant was built in 1903. In 1952, the old pumps were replaced. Nearly all the Crane valves were found in good condition and put right back in service on the new pumps.

It's no easy job these Crane 6 and 8-inch, 125-pound brass-trimmed gate valves have been doing since 1903. The plant operates on 80-day continuous beet sugar campaigns. In spite of intermittent operation, and with periodic routine maintenance only, the Crane valves never fail to operate freely, smoothly, and seat tightly. For 50 years they have assured dependable, positive flow control in event of pump failure—and they're still doing it.

THE VALVE

Here is today's model of these "50-year service record" Crane 125-pound iron wedge gates. Still made to the most rigid quality standards, these modern valves keep building unusual performance records in every industry. They come in patterns for every need. See your Crane Catalog or your Crane Representative.



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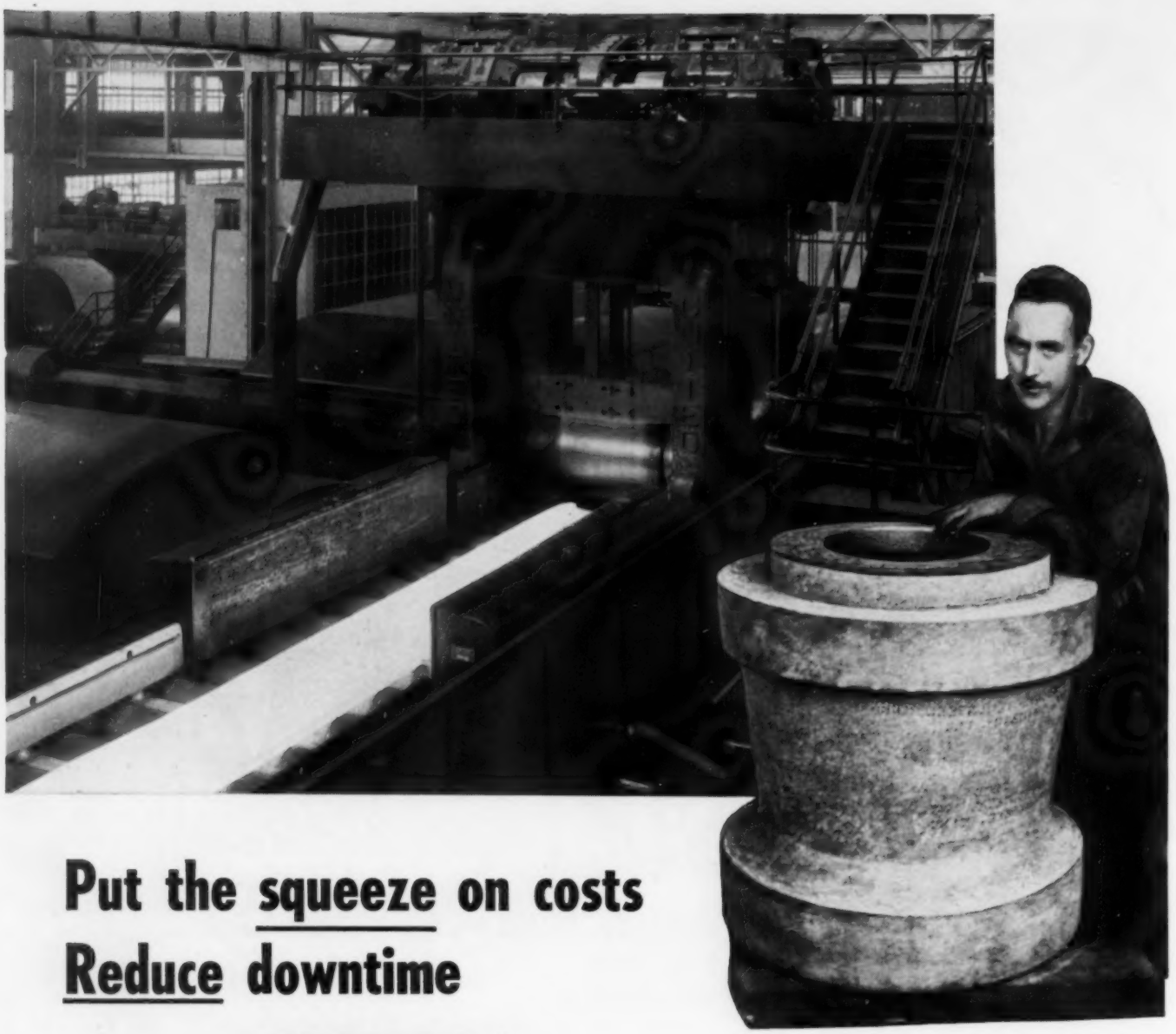

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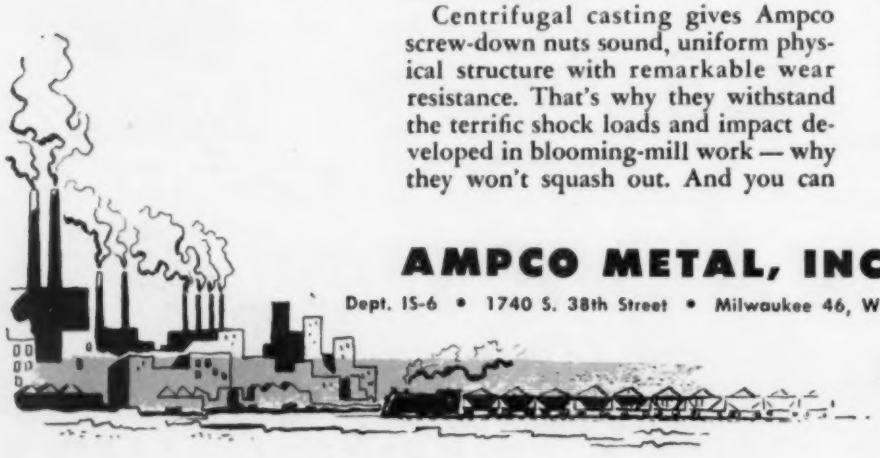
Reduce downtime
...use AMPCO*
Screw-down Nuts

CUTTING costs is old stuff to Ampco Metal. And when Ampco is centrifugally cast into screw-down nuts for blooming-mills, you find no equal for top performance — lower costs — longer runs.

Centrifugal casting gives Ampco screw-down nuts sound, uniform physical structure with remarkable wear resistance. That's why they withstand the terrific shock loads and impact developed in blooming-mill work — why they won't squash out. And you can get Ampco screw-down nuts in sizes up to 6000 pounds.

Wherever extra toughness and wear resistance is important, you find Ampco Metal on the job — in slippers, wear plates, flash-welding dies. Its high resistance to corrosion saves money for you in pickling equipment and similar applications.

Your nearby Ampco field engineer is glad to give you full information. Contact him today or write us.



AMPCO METAL, INC.

Dept. IS-6 • 1740 S. 38th Street • Milwaukee 46, Wisconsin

*Reg. U. S. Pat. Off.

AMPCO®

G-19

AGING

ALUMINIZING

ANNEALING

BILLET HEATING

BRAZING

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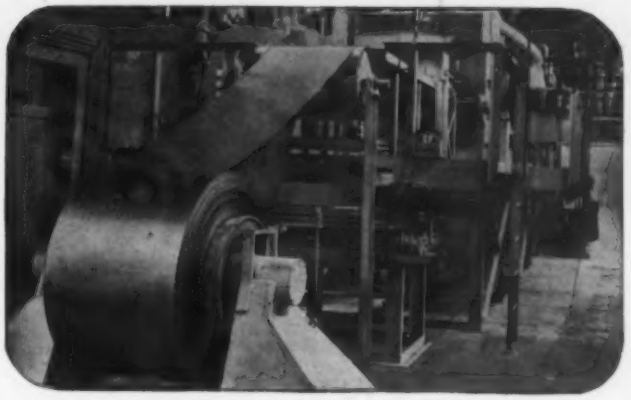
SINTERING

SOLUTION TREATING

STRESS RELIEVING

STRIP— ANY PROCESS

SPECIAL ATMOSPHERE TREATMENTS AND OTHER PROCESSING



EF continuous strip line — for annealing, galvanizing, aluminizing, and producing various surface and metallurgical conditions on ferrous and nonferrous strip.

EF gasfired continuous roller hearth special atmosphere furnace bright annealing long straight lengths of tubing.

EF PRODUCTION FURNACES

for these and other processes

Reflecting more than 30 years of continuous research, experience and outstanding engineering accomplishments, EF production furnaces combine high heating efficiency — accurate, automatically controlled cycles — high fuel economy — and produce products with uniform physicals and surface finish year after year.

For advanced engineering designs that minimize maintenance and produce high hourly outputs, turn your production furnace problems over to the experienced EF furnace engineers — ***It pays.***

THE ELECTRIC FURNACE CO.

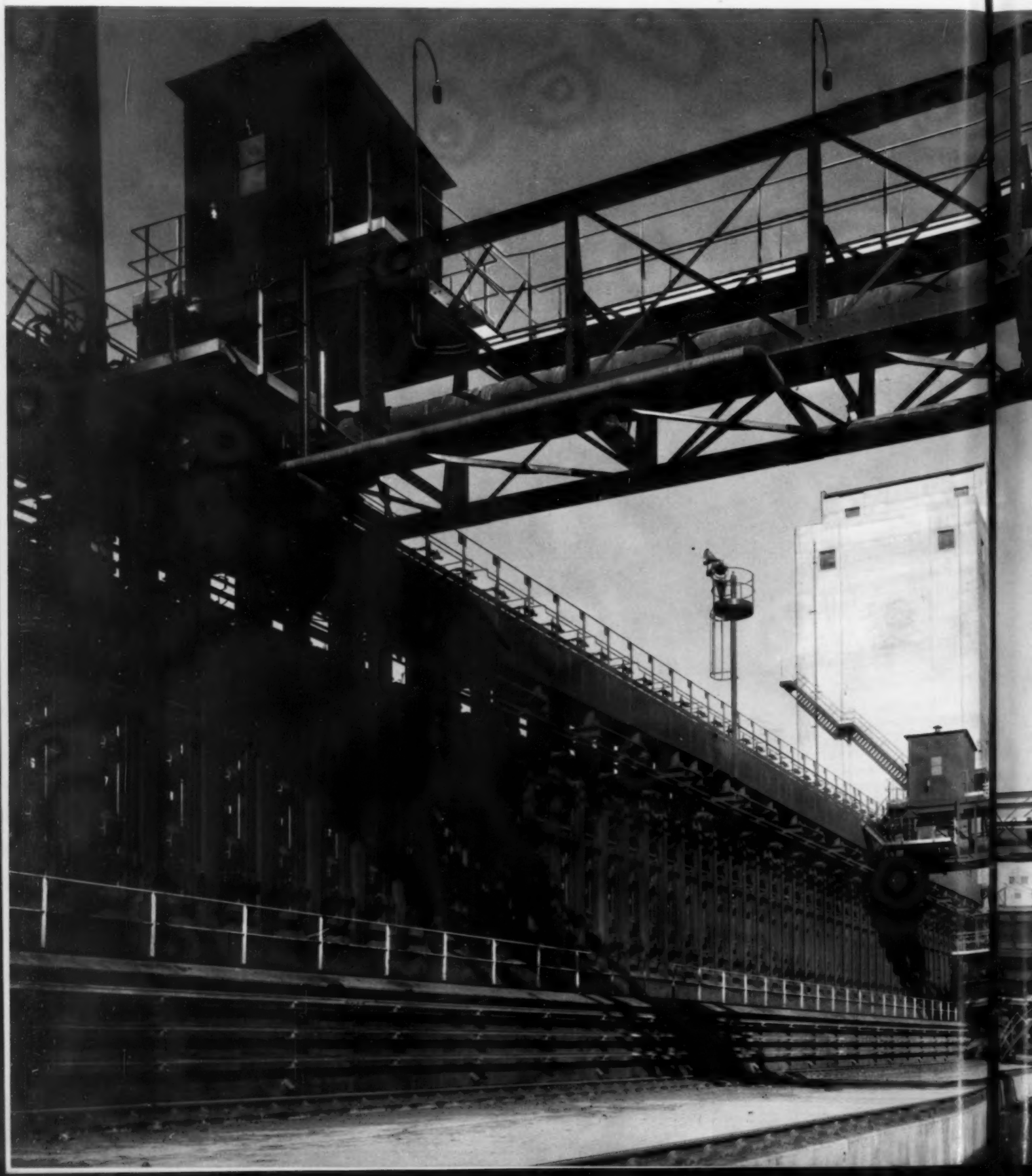
GAS FIRED, OIL FIRED AND ELECTRIC FURNACES FOR ANY PROCESS, PRODUCT OR PRODUCTION

Salem - Ohio

Canadian Associates • CANEFCO LIMITED • Toronto 1, Canada

An EF continuous bright annealing furnace in which the wire is conveyed through the various zones on two parallel rows of trays.

For rebuilding or repairing coke ovens...



...you can count on Koppers

● Koppers has designed and erected a great many coke-oven plants similar to the one shown here. In fact, the constructing of new coke ovens represents a major part of our services to the Iron and Steel Industry.

However, what may not be as well-known are the services we are bringing to bear on the coke-oven repair and rebuilding projects that are now assuming increasing importance in the programing of many companies.

For such projects, we extend to you the same scope of engineering skills and experience, the same meticulous adherence to the client's best interests, the same ability to engineer economies and superior performance into the finished job that have characterized our work on new construction.

Whatever your needs in coke-oven repair or rebuilding as well as for new construction . . . we will look forward to the opportunity of discussing your problems with you.

Constructing, rebuilding or repairing coke ovens is just one way in which Koppers serves the steel industry. For any kind of metallurgical construction, you can count on Koppers.

KOPPERS

Engineering and Construction Division

KOPPERS COMPANY, INC. • PITTSBURGH 19, PA.

HOT STRIP DESCALING

Thin jets of water strike with tremendous force against sheets of steel. Harmful scale is dislodged, broken up, carried away. The steel passes on—and its producer is assured of higher quality, more accurate gauge and better surface finish.

Such is the story every day, in one steel plant after another, wherever an *Aldrich Descaling System* is on the job.

In these plants Aldrich Direct Flow Pumps and Spray Nozzles, tied together in hard-hitting teams, do their jobs quickly and efficiently. The pumps build up high water pressures to nozzles, which, in turn, are designed to produce knife-edged lines of water with an impinging force equal to 95% of the potential energy supplied to the nozzle orifices. This powerful action breaks the scale in a fraction of a second; the deflected stream of water washes away the loose scale.

The jet action and striking force developed by Aldrich Patented Spray Nozzles give far more effective descaling than nozzles which produce jets of equal force but with larger impinging area . . . a claim proven in hot strip as well as billet descaling! High efficiency of cutting spray force results in thorough descaling *without* excessive cooling due to overabundant use of water.

There's an Aldrich Descaling System—or Pumps or Spray Nozzles—to meet *your* particular needs. Write us today for complete information.

The Aldrich Pump Company

21 PINE STREET • ALLENTOWN, PENNSYLVANIA

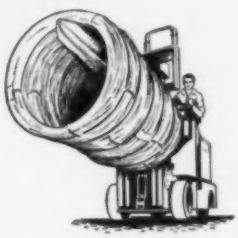
Representatives in Principal Cities

ALDRICH

For industrial trucks... Exide-Ironclad now offers

★ 20% more capacity in the same space

★ Lowest cost per A. H. to own and operate



These are the features that contribute to the higher capacity and longer life of the T-H Battery:

Its larger positive plates, containing corrosion-resistant Silvium, are different . . . unique . . . exclusive! No other type of positive plate construction offers you the advantages of the T-H Exide-Ironclad, with its slotted plastic tubes, permanently sealed on the bottom with polyethylene tube sealer. More active material is exposed to the electrolyte, resulting in greater power. More active material is retained, providing higher battery capacity for a longer working life.

Other features include improved negative plates . . . practically indestructible Pormax separators . . . new sealing compound . . . shock-proof molded jar . . . unbreakable quarter-turn vent plugs of plastic . . . corrosion-resistant tray coating.

Now-more than ever before...
YOUR BEST POWER BUY AT ANY PRICE!

1888 . . . DEPENDABLE BATTERIES FOR 65 YEARS . . . 1953

The new T-H Exide-Ironclad BATTERY

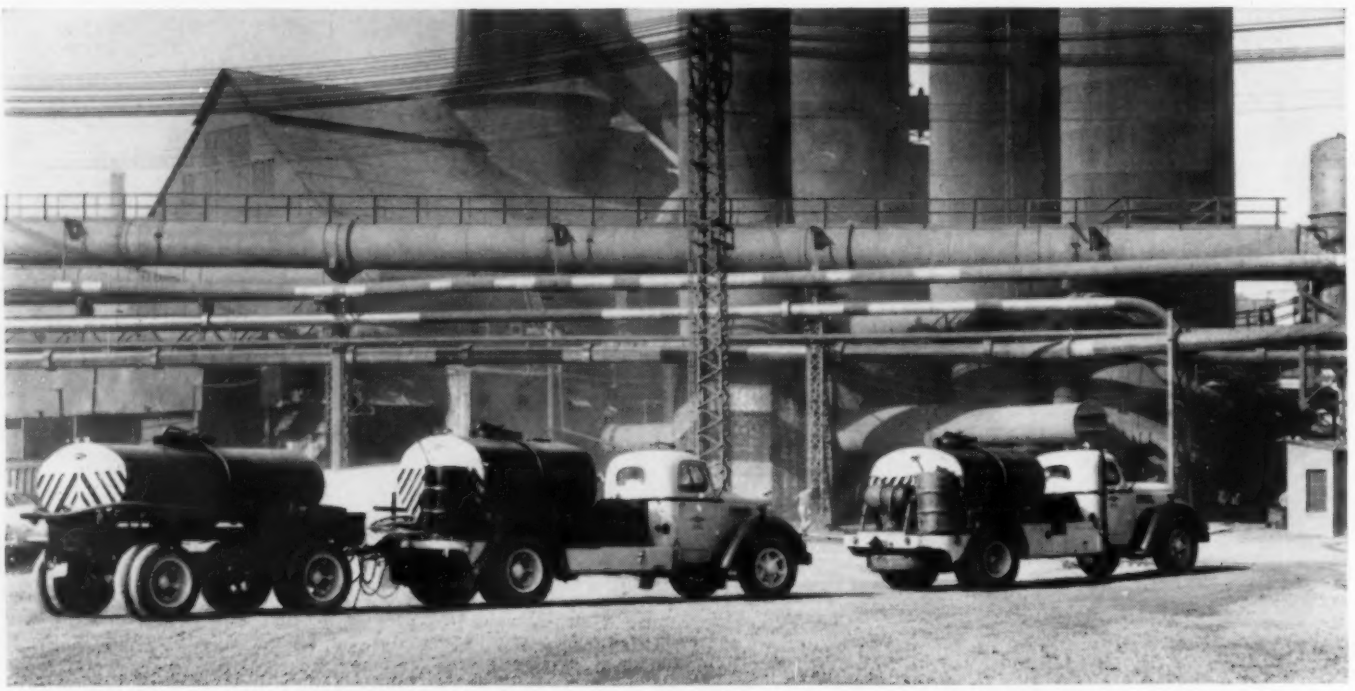
Thrifty Hauler

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 2 • *Exide Batteries of Canada, Limited, Toronto*

"EXIDE", "EXIDE-IRONCLAD", "SILVIUM", "PORMAX", *Reg. T.M. U.S. Pat. Off.*

600 FEET OF COKE OVEN GAS MAIN CLEANED CHEMICALLY WHILE IN USE

DOWELL-designed jet nozzle removed brittle deposits from 30-inch gas line under pressure



Tar and naphthalene deposits had accumulated in a 600-foot section of a steel company's 30-inch gas main. The line supplied coke oven gas to a strip mill two miles away. Pressure drop through this line had doubled, forcing the company to buy large quantities of natural gas to supply the strip mill. The company's attempts to clean the line with steam and hot water failed . . . then Dowell was called.

Dowell Service cleaned the line in only three working days, using chemical solvents, specially-designed high-pressure jets and mobile high-pressure pumps. The steel company was especially pleased because Dowell Service did not interfere with the regular function of the line.

What about your maintenance problems? Dowell engineers are experienced in the chemical cleaning of boilers, blast furnace cooling systems, stoves, water lines, gas washers and many other types of steel plant equipment. Dowell engineers use special pump trucks and control equipment to apply liquid solvents by filling, spraying, jetting, cascading or vaporizing. No scaffolding is required. Dismantling and downtime are kept to a minimum. Some equipment can be cleaned in operation.

For more information on Dowell Service and how it can be used to your advantage, call the nearest Dowell office. Or, write directly to Tulsa, Dept. F 29.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

Date-line Diary...

May 1

▲ Six Western European countries, France, Germany, Belgium, Italy, The Netherlands, and Luxembourg removed national trade barriers today by forming a single market for steel. Jointly their production totals 42,000,000 tons a year compared with annual output in the U. S. of over 100,000,000 tons.

May 2

▲ The Federal Reserve Board reported consumer credit outstanding on March 31, 1953 totaled $25,600,000,000. This was $5,000,000,000 greater than March 31, 1952.

May 4

▲ Inland Steel Co. increased prices of "extras" on steel bars. Average increase amounted to $4 a ton.

▲ The Bolivian government, Mine Owners, and U. S. have reached an agreement on wolfram, the ore of tungsten, purchases. This may clear way for resumption of U. S. purchases of Bolivian tin.

▲ The Commerce and Labor Depts. reported that new construction for the first four months of 1953 totaled $9,600,000,000. This is $500,000,000 or 6 per cent above the like period of 1952.

▲ AISI reports the operating rate for the coming week is scheduled at 100.3 per cent of capacity or 2,262,000 tons of ingots and steel for castings. This is the same as last week.

May 5

▲ U. S. Steel Corp. announced it plans to raise prices of finished products where production costs have increased, but base prices will remain unchanged at present.

May 6

▲ Due to a big boost in the nation's steel output, Britain discontinued the allocations program for steel products which started 15 months ago. Output in production is sufficient to meet a 6 per cent rise in domestic demand.

▲ Steel rationing ended in Great Britain except for tin plate. Steel production in April was at an annual rate of 18,124,000 tons. Steel production for 1953 is estimated at 17,500,000 tons, up 1,360,000 tons from 1952.

May 7

▲ CIO Steelworkers were scheduled to begin primary wage negotiations with U. S. Steel Corp. on May 14. Negotiations will also be made with 80 large steel companies.

▲ March inventory stocks held by manufacturers, wholesalers, and retailers were $200,000,000 above February levels. However, the rate of gain in the March quarter declined to $130,000,000 monthly.

▲ Price of grade A tin has been increased 2¢ a pound in New York.

▲ U. S. aluminum industry broke all records in March with an output of 208,919,425 pounds. Higher records are anticipated due to aluminum industry's expansion program which is not yet completed.

▲ Stockholders of Allis-Chalmers voted to increase the authorized common stock from 3,750,000 shares to 5,000,000 shares, and to change common stock from shares of no par value to shares of $20 par value each.

May 8

▲ The Senate Foreign Relations Committee predicts that U. S. deliveries of military equipment to the allies should reach $5,000,000,000 for the fiscal year starting July 1.

May 11

▲ Westinghouse Air Brake Co. made known its purchase of the earthmoving tractor and related business of R. G. LeTourneau Inc. for $19,500,000. In 1952 LeTourneau reported sales of $55,496,529 with earnings equal to $3.90 a share.

▲ The Federal Deposit Insurance Corp. reported that commercial banks' net income for 1952 rose to $900,000,000 or 9 per cent above 1951.

▲ The F. W. Dodge Corp. reports a grand total of $1,741,542,000 for contract awards in April, up 29 per cent over March and up 9 per cent over April 1952.

▲ The AISI reports operations for the coming week are scheduled at 100.5 per cent, equivalent to 2,266,000 tons of ingots and steel for casting, compared with 2,259,000 tons for the previous week.

May 12

▲ ARI reports April deliveries of new freight cars totaled 6839 compared with 6679 in March. Orders totaled 2432 leaving a backlog at the end of the month of 62,637 cars.

▲ St. Joseph Lead Co. declared the reason for decline in domestic prices of metals is the overdumping of foreign metals on U. S. markets. Coal executives, encountering the same difficulty, have urged Congress to restrict excessive imports of coal

May 14

▲ Republic Steel Corp. announced that sales and operating revenues for 1952 totaled $925,088,437 as compared with $1,060,371,877 in 1951; net income for 1952 was $44,274,053, and $54,921,541 in 1951; income per share of common stock for 1952 was $7.21, and $9.03 in 1951.

▲ March shipments of finished steel products set a record at 7,436,919 net tons which passed the previous record of October 1952 by 281,000 tons. Shipments of stainless steel products for the first quarter of 1953 are 24 per cent higher than 1952.

▲ Youngstown Sheet & Tube Co. announced an

increase in pipe extras, and U. S. Steel Corp. disclosed boosts in additional products.

▲ Secretary of Treasury, Humphrey, states that present public debt stands at $265,500,000,000.

▲ T. M. Girdler, chairman of Republic Steel, declared that peace in Korea would not reduce steel demand to the extent many people seem to fear.

▲ U. S. Steel Corp. now prices ferromanganese on a net ton basis. The new price is $200 per net ton on 74-76 per cent Mn. Old price was $228 per gross ton.

▲ American Steel & Wire Co. broke ground in Cleveland for its new blast furnace.

May 16

▲ U. S. Steel Corp. announced the start of a new $7,500,000 project at the Edgar Thomson plant and has completed one costing over $35,000,000 at Pittsburg, Calif. which raised sheet and tin plate capacity there 68 per cent.

May 18

▲ The Department of Commerce reported output for the first quarter in close-balance with demand. Flow of goods for final use increased $8,500,000 over the last quarter of 1952.

▲ According to AISI, operating rate for industry this week is scheduled at 100.2 per cent of capacity or 2,259,000 tons of ingots and steel for castings, compared with production of 2,262,000 tons one week ago.

▲ AISI reported that iron and steel industry had an estimated payroll of $828,054,000 for the first quarter of 1953, nearly $100,000,000 above the same period in 1952. Employment for the first quarter of 1953 was estimated at 683,900 as compared with 672,700 for the same period in 1952.

May 19

▲ Cost of lead was increased ¼¢ to 12¾¢ a pound in New York.

May 20

▲ President Eisenhower, in his radio address, asked for extension of excess profits tax to December 31 and called for extension of the 52 per cent rate on regular corporation profits beyond next April 1 when it is due to drop to 47 per cent.

May 21

▲ A 5-week strike at Ford Motor Co.'s Canton, Ohio plant resulted in the beginning of shutdowns of manufacturing and assembly plants. Nearly 85,000 workers will be laid off in the next week.

▲ NPA announced that to enable the Government to distribute nickel supplies with more fairness, nickel rationing will be placed on a monthly basis effective July 1.

▲ McLouth Steel Corp. plans to raise $105,000,000 by selling preferred stock to American Metal Products Co. and General Motors Corp. Primary purpose for raising this amount is to expand company's facilities at Trenton, Mich.

May 23

▲ 350,000 General Motor Co. employees will have 19¢ of their present 24¢ cost of living allowance made part of their base pay. The remaining 5¢ will continue subject to living costs.

May 25

▲ Machine tool makers stated that April orders have dropped for the first time since last November. Sales were $82,000,000 as compared with $95,000,000 for March.

▲ Directors of Timken-Detroit Axle Co. and Standard Steel Spring Co. voted to consolidate the two companies into one firm to be known as Rockwell Spring & Axle Co.

▲ According to AISI, operating rate for industry this week is scheduled at 100.6 per cent of capacity. This is equivalent to 2,268,000 tons of ingots and steel for castings compared with 2,250,000 tons one week ago.

May 26

▲ April bookings of fabricated structural steel totaled 305,842 tons, the highest monthly figure for two years, the AISC reported. Shipments totaled 259,675 tons leaving a backlog on April 30 of 2,167,758 tons.

▲ Grains led a general slump in markets, wheat broke 2¢ a bushel, and other cereals dropped to new lows for the season.

May 27

▲ Aluminium Ltd. has contracted to sell 786,000 tons aluminum metal over a period of six years to Aluminum Co. of America and Kaiser Aluminum & Chemical Sales, Inc.

▲ Steel scrap sold at $38 a ton in Pittsburgh, less $2 from previous price, and down $6 from ceiling price.

▲ Lead increased ¼¢ to 13¼¢ a pound in New York.

May 29

▲ Benjamin F. Fairless announced that U. S. Steel Corp. is starting a new merchandising policy. Prices will be posted, and no customer will get special benefits. Posted prices will fluctuate with demand and will meet all competition.

▲ General Motors Corp. will adapt pension plans along lines granted CIO Auto Workers by Ford and Chrysler. Retired personnel will receive $1.75 a month for each year of service instead of $1.50 as previously issued, giving a raise for workers with 30 years service from $130 to $137.50 including $85 in Federal Social Security benefits.

May 31

▲ The International Nickel Co. of Canada announced that it has signed a contract under which the U. S. Government has purchased for quick delivery a total of 120,000,000 lbs metallic nickel and 100,000,000 lbs electrolytic copper. The contract is with the Defense Materials Procurement Agency.

CALL Curry! FOR STEEL PLANT EQUIPMENT

2000 H. P. SLIP RING MOTOR
— PERFECT CONDITION — IMMEDIATE DELIVERY

The motor shown at right is in perfect operating condition, complete with same-as-new controls, including stop and start, reversing, in and out plugging and liquid slip regulator. It's a General Electric, 3 phase, 60 cycle, 2200 V., 236 RPM. Type MT-30-2000-240 Serial No. 5217277. Complete details gladly given on request.

The following are a few items from our large stock of steel plant equipment. If you don't find what you need, write, phone or wire us today.

42" x 3/16" UNITED ENGINEERING AND FOUNDRY COMPANY POWER SQUARING SHEAR, Complete with Motor and V-Belt Drive.

36" x 3/16" UNITED ENGINEERING AND FOUNDRY COMPANY POWER SQUARING SHEAR, Complete with Motor and V-Belt Drive.

120" x 1/4" CINCINNATI POWER SQUARING SHEAR, Complete with Motor and V-Belt Drive.

80" HYDRAULIC STRETCHER LEVELLER, Capacity 80" wide x 200" long, complete with all Hydraulic Pumps, Controls, and Motor.

400 H.P. GEAR REDUCTION UNIT (WESTINGHOUSE), Single Reduction, Helical Gears, Ratio 6 to 1.

600 H. P. GEAR REDUCTION UNIT (FARREL-BIRMINGHAM), Ratio 2.95 to 1, Single Reduction, Rebuilt 1950.

CANTON ALLIGATOR SHEAR, Capacity 3" dia. rounds. 26" knives. Complete with 35 H.P. A.C. Motor and Controls.

50 H.P. CROCKER-WHEELER D. C. MILL TYPE MOTOR. Size EW, 220 V. 560 RPM.

D & K No. 2 ALLIGATOR SHEAR, 21" Knives, 7½ H.P. 3/60/220-440 Volt Motor.

5 TON OVERHEAD ELECTRIC CRANE, 47' Span D.C. Cab Operated.

Write today for the Curry List of Available Steel Plant Equipment!

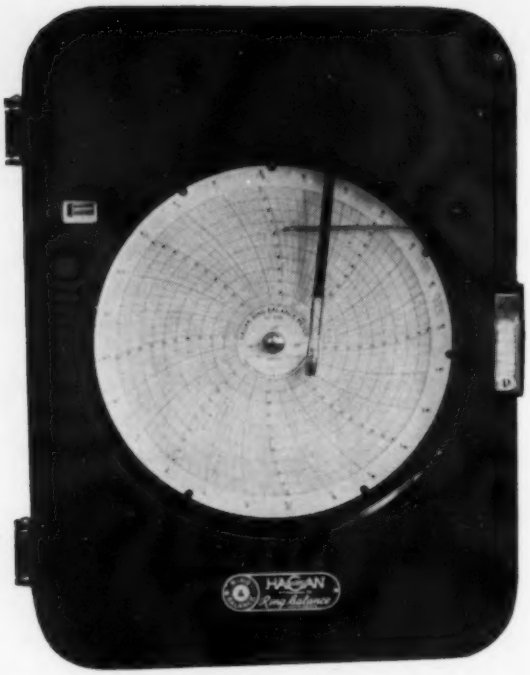
ALBERT Curry & CO., INC.

STEEL PLANT EQUIPMENT

Cable Address — Curmill Pittsburgh

940 OLIVER BUILDING • PHONE ATLANTIC 1-1370
PITTSBURGH 22, PA.

When you install



HAGAN RING BALANCE FLOW METERS

You install

Accuracy

Dependability

Durability

Versatility

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AUTOMOTIVE AND
AERONAUTICAL TESTING LABORATORIES

Hagan Ring Balance Flow Meters give dependable readings over the chart range, and give good response at low flow rates.

The calibration may be checked under full static pressure conditions by a simple check-weight method. One man can check calibration in a few minutes.

The simplicity of design, coupled with sturdy construction, assure long meter life and low maintenance costs.

The Hagan Ring Balance Meter is the most versatile meter made. Whatever your metering problems, our engineers will be glad to show you how Hagan Meters can help you solve them.

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Please send me further information on Hagan Ring Balance Meters.
I am particularly interested in_____

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Cut wire fence re-coating costs!

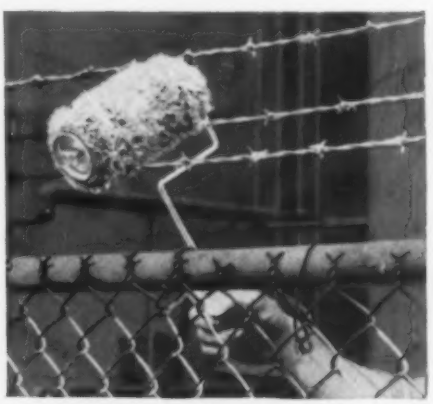
Users Report Savings of 30% to 40% With Rust-Oleum Extra-Long Nap Lamb's Wool Roller!

Special roller glides easily over wire sections. (Rusted sections have already been primed with Rust-Oleum 769 Damp-Proof Red Primer to Stop Rust.) Finish coat is Rust-Oleum 470 R.M. Aluminum.

A *new, exclusive, different-type* roller! Greater diameter, specially selected skins, extra-long Lamb's Wool – all combine to give you more coverage faster and easier in the new Rust-Oleum Roller-Coating System.

Close-up shows how Extra-Long Nap Wool reaches around to coat approximately 70% of other side of fence at same time. Rust-Oleum's *exclusive* penetrating qualities saturate cross wire sections for desired mil thickness.

Man follows with "dry" roller on opposite side of fence to catch and use surplus "tears" and quickly coat remaining 30% of wire sections.



Even barbed wire sections can be roller-coated in one easy pass. 99% of the material is used on the fence – *not* on the workers, *not* on the ground.

On long distances of fencing, a 5 man production "team" can achieve even greater savings. The first man wirebrushes the surface to remove dirt, dust, rust scale, etc. The second man applies Rust-Oleum liberally by roller, coating the wire sections and barbed wire. The third man follows on the opposite side of the fence with a "dry" roller to catch and use the surplus. The fourth and fifth men work on opposite sides of the fence, brushing the pipe framework and the barbed wire arms. See how this new Rust-Oleum system can save you money. Attach coupon to your letterhead, mail *today*.

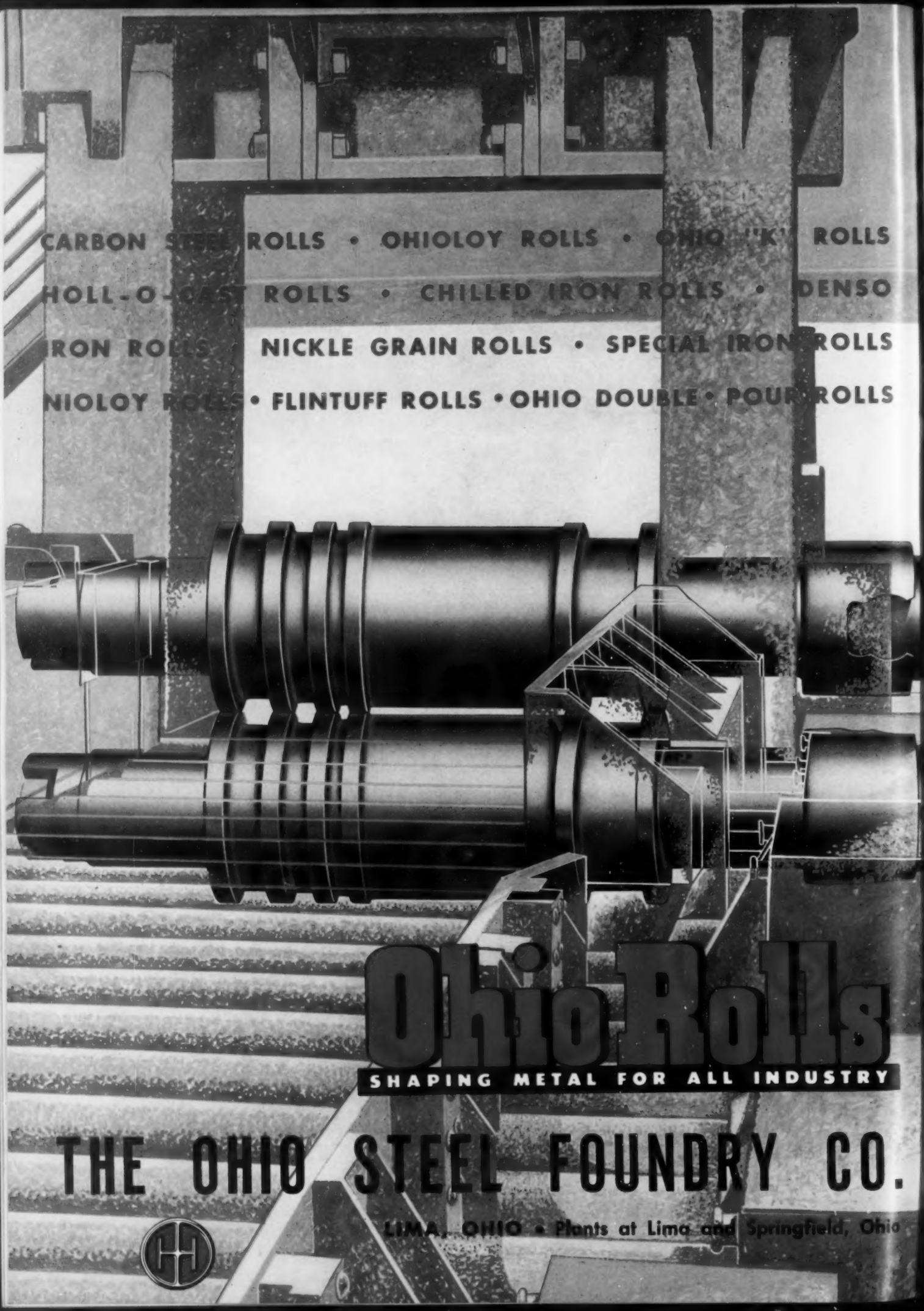
RUST-OLEUM®

STOPS RUST!

ATTACH TO YOUR LETTERHEAD—MAIL TODAY!

RUST-OLEUM CORPORATION
2441 Oakton Street, Evanston, Illinois

Please show us how your new Extra-Long Nap Lamb's Wool Roller will cut our wire fence re-coating costs. Include prices, complete literature about Rust-Oleum and nearest sources of supply. We have approximately _____ yards of wire fencing.


CARBON STEEL ROLLS • OHIOLOY ROLLS • OHIO "K" ROLLS
HOLL-O-CAST ROLLS • CHILLED IRON ROLLS • DENSO
IRON ROLLS • NICKLE GRAIN ROLLS • SPECIAL IRON ROLLS
NIOLOY ROLLS • FLINTUFF ROLLS • OHIO DOUBLE • POUR ROLLS
Ohio Rolls
SHAPING METAL FOR ALL INDUSTRY
THE OHIO STEEL FOUNDRY CO.
LIMA, OHIO • Plants at Lima and Springfield, Ohio

Industry News...

AMERICAN STEEL & WIRE BREAKS GROUND FOR NEW BLAST FURNACE AT CLEVELAND

▲ Ground was broken on May 12, for American Steel & Wire's new blast furnace for production of merchant pig iron at the Central Furnaces & Dock plant, 2650 Broadway, Cleveland, Ohio. Harry L. Jenter, Cleveland district manager of operations for this Division of United States Steel Corp., turned the first spadeful of earth for the new giant with a special nickel plated shovel. The new unit will be known as "A" furnace.

The ceremony took place in the shadow of "B-2" furnace, which rests on the foundations of the first blast furnace built in the Cuyahoga Valley.

Among those present for the ground-breaking were Mayor Thomas A. Burke and company officials, including W. F. Munford, president of American Steel & Wire; V. H. Leichliter, operating vice president; John Graham, general manager of sales; R. M. Braund, comptroller; and Floyd A. Garman, chief engineer. Officials of Arthur G. McKee and Co. present were H. E. Widdell, president, and William A. Haven, vice president.

The new furnace, being built to serve the growing demand for iron among the iron and steel foundries in the Cleveland area, will be 106 ft high and will turn out about 1,350 tons of pig iron a day.

Mr. Garman estimates it will take about 14 months to build the furnace and all special equipment, and to integrate the new unit with the other facilities in the plant.

The most modern equipment for eliminating air and water pollution is provided for in the design of the furnace.

A primary water gas washer and a secondary electrostatic gas cleaner will remove ore and coke dust from the gas coming off the top of the furnace before it is reused to heat the stoves and underfire the boilers.

Millions of gallons of water used in cooling the furnace and washing the gas will be cleaned in special sludge removal equipment to return the water to the Cuyahoga River cleaner than when it was taken out.

Walter F. Munford (left) president of American Steel & Wire Division of U. S. Steel Corp. is joined by Mayor Thomas A. Burke of Cleveland, Ohio at the ground breaking ceremonies for Cleveland's new 228-ft high merchant iron blast furnace which will produce 1350 tons of pig iron daily for hundreds of foundries in the Cleveland area, Ohio, Michigan and Pennsylvania. The new furnace is located at Central Furnaces and Docks plant of American Steel and Wire.

OPENS WICHITA SALES CENTER AND WAREHOUSE

▲A huge new warehouse and sales center for steel products, chemicals, and fuel has been opened in Wichita, Kan. by Colorado Fuel and Iron Corp., it was announced by A. F. Franz, president of the corporation.

Serving the rapidly expanding agricultural, oil, construction, and manufacturing industries of Oklahoma, Nebraska, Missouri and Kansas, this modern sales and warehouse center will occupy 30,000 sq ft of floor space. It will be an important sales distribution point for the products of CF&I's eastern and western plants. Giant spools of wire rope for the oil and construction industries are stored alongside farm fence, barbed wire, nails, screen cloth, and a host of other products designed to serve agricultural and industrial needs.

Sales offices occupy 2,000 sq ft of the floor area, and will handle distribution of coal and coke and various chemicals—including benzol, napthalene, creosote, and fertilizer—as well as CF&I's steel and wire products.

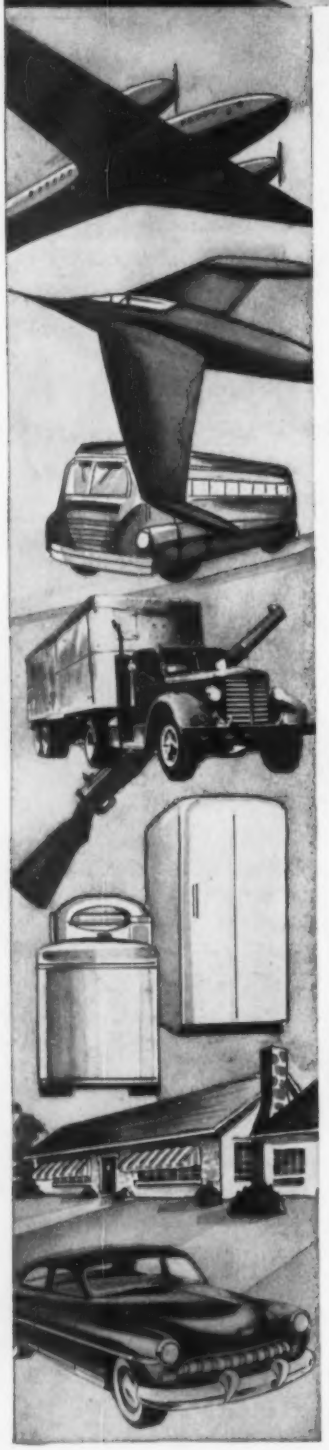
"Wichita and its surrounding market area has shown outstanding growth, and our new distribution center is one segment of CF&I's program of expansion and diversification," Mr. Franz said, "and at the same time represents our response to the greatly increased demand for our products from distributors in this section of the West."

Last month's steel production and shipments at the fully-integrated Pueblo, Colo., mill of CF&I set all-time records, and the recent acquisi-

CHEMICALS
ACP
PROCESSES

phosphate coating chemicals

TO MAKE YOUR PRODUCT DURABLE



PAINT BONDING

"GRANODINE"® forms a zinc-iron phosphate-coating bond on sheet metal products—automobile bodies and fenders, refrigerator cabinets, etc.—for a durable, lustrous paint finish.

"LITHOFORM"® makes paint stick to galvanized iron and other zinc and cadmium surfaces.

"ALODINE",® the new ACP protective coating chemical for aluminum, anchors the paint finish and protects the metal.

RUST PROOFING

"PERMADINE",® a zinc phosphate coating chemical, forms on steel an oil-adsorptive coating which bonds rust-inhibiting oils such as "Granoleum."

"THERMOIL-GRANODINE"® a manganese-iron phosphate coating chemical, forms on steel a dense crystalline coating which, when oiled or painted, inhibits corrosion.

PROTECTION FOR FRICTION SURFACES

The oiled "THERMOIL-GRANODINE" coating on pistons, piston rings, cranks, camshafts and other rubbing parts, allows safe break-in operation, eliminates metal-to-metal contact, maintains lubrication and reduces the danger of scuffing, scoring, galling, welding and tearing.

IMPROVED DRAWING AND COLD FORMING

"GRANODRAW"® forms on pickled surfaces a tightly-bound adherent, zinc-iron phosphate coating which facilitates the cold mechanical deformation of steel, improves drawing, and lengthens die life.

Send for descriptive folders and Government specifications chart on the above chemicals. Write or call for more information on these products, and advice on your own metal-working problem.

AMERICAN CHEMICAL PAINT COMPANY

General Offices: Ambler, Penna.

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tion of John A. Roebling's Son Corp. added cold rolled wire and strip, electric wire and cable and bridge construction materials to the corporation's line of steel products. CF&I has the ninth largest capacity of the 84 steel producing companies.

DEVELOPS NEW TYPE STAINLESS STEEL

▲ An austenitic alternate for 18-8 stainless has been developed by Allegheny Ludlum Steel Corp. which offers good cold working properties, good weldability, and good ductility. Produced with manganese, chromium, and less than one per cent nickel as principal alloying elements, this steel offers promise of widespread usefulness. After being under development for many months chromium-manganese stainless strip is now being produced in substantial quantities, and is available in most other forms. It is believed by the company to be the vanguard of a new family of stainless steels that will be a permanent addition to the stainless market.

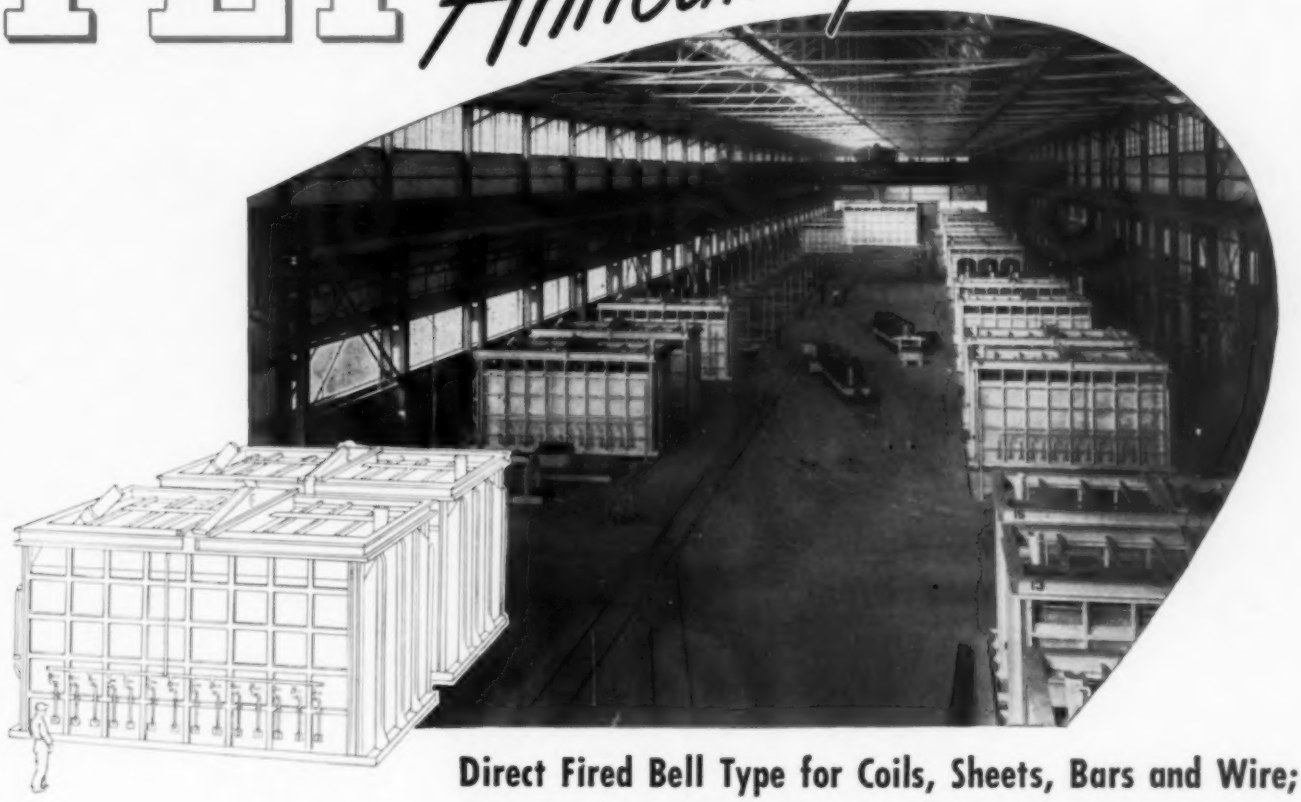
The development work was undertaken because of the restricted usage of nickel, in an effort to obtain an austenitic stainless steel with less than one per cent nickel. This steel is needed where straight chromium steels are unsatisfactory as substitutes for 18-8.

In applications where critical requirements include the mechanical properties of welds, ductility, nonmagnetic qualities, and cold working to high strength, the chromium manganese steels should be considered. However, present types of manganese austenitic stainless steels are not cure-alls for every application, particularly where extreme corrosion resistance is required. It is expected that where straight chromium steels are serving satisfactorily as an alternate for the 18 per cent chromium—8 per cent nickel steels, consumers will continue their use.

DU PONT PLANS NEW SYNTHESIS-GAS UNIT

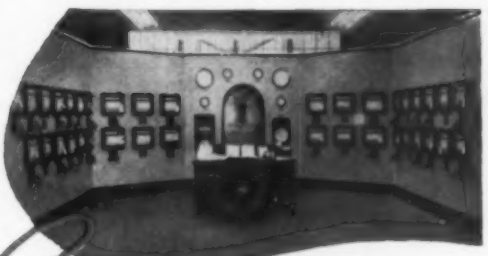
▲ Coke ovens and gas generators, standard for years in the conversion of coal into basic products of industrial chemistry, may be on their way out at the Du Pont Belle, W. Va., works together with their inevitable smoke and soot.

F·E·I· *Annealing Furnaces*



Direct Fired Bell Type for Coils, Sheets, Bars and Wire; Complete Heating Lines for All Kinds of Armament: Guns, Armor Plate, Shells, Bombs, etc.

Fast! Efficient! Improved! F.E.I. Annealing Furnaces and Complete Armament Heating Lines are planned, engineered and built to do an outstanding job. Leaders of industry in America and abroad recognize Furnace Engineers' advanced heating methods, based on over thirty years' experience. F.E.I.'s patented, automatically controlled combustion system provides high metallurgical quality and economical operation. Consult us about improving YOUR plant's annealing performance—whether the need is for an entirely new installation or the modernization of existing furnaces.



Completely Automatic

- ***Easy to operate — even without previous experience.***
- ***Maintenance practically nil.***
- ***Minimum critical materials required.***

Photographs above show a battery of F.E.I. annealing furnaces in a large eastern steel mill; all furnaces are controlled automatically from a single Remote Control Room. F.E.I. also builds Open Hearth Furnaces, Soaking Pits, Continuous Reheating Furnaces, Forging Furnaces, and other heating lines.

FEI

FURNACE ENGINEERS, INC.

Affiliated with BRASSERT CORPORATION, NILES CONSTRUCTION CO. and STANDARD BOILER & PLATE IRON CO.

General Offices: 210 BOULEVARD OF THE ALLIES, PITTSBURGH, PA.

"MULTICUT" "TUFCUT" "HOT WORK"
Wapakoneta
SHEAR BLADES
and ROTARY KNIVES
Any type or size blade of proper Alloy with correct hardness and temper for every type shearing machine and every kind of job.
TOOL
Rx ENGINEERED TO THE JOB
Every Wapakoneta blade is made to exact specifications, designed for the particular job. Complete records with order number of each blade makes possible duplication of exact size and temper at any time.
The WAPAKONETA MACHINE CO.
Shear Blade Specialists Since 1891
Wapakoneta, Ohio

The company recently disclosed plans for building a production-scale unit to utilize a new, continuous, and soot-free process for producing synthesis gases, starting point for most operations at the plant.

The process, known as coal-partial-combustion, was evolved in eight years of research by the Belle works technical section. In addition to its promise of providing an answer to air-pollution problems inherent in the old system, the process is expected to be considerably more efficient in the use of coal.

If operation of the initial large-scale unit confirm pilot-plant results, the company contemplates removal of all the Belle works' picturesque but inherently dirt-making ovens and generators. Such a move, it was pointed out, would mark the passing of an era at the Du Pont plant, since the present "water gas" system is the one by which the company pioneered here 27 years ago in the capture, from the air, of nitrogen for industry and agriculture.

To build the coal-partial-combustion unit, first of its kind in the country, and dismantle portions of the gas-generating equipment which it will replace, will cost more than $4,000,000. Dismantling work has been started.

Additional new synthesis-gas units would have to be built to replace all of the capacity of existing facilities. The coke ovens and gas generators, the company pointed out, will be the only significant sources of soot remaining at the plant after completion early next year of a $2,300,000 fly-ash abatement installation in the boiler house.

Research on the new process cost $1,600,000, including two years operation of a pilot plant capable of producing enough gas to supply the fuel needs of a small town.

In the new process, low-fusion-ash coal, instead of less plentiful coking varieties, will be crushed and reduced to the fineness of talcum powder in pulverizing equipment which will smash coal particles against each other in steam-driven jets.

The powdered coal will be blown into a ceramic-lined furnace where, at carefully controlled temperatures, the volatile matter and fixed carbon will be burned in the presence of steam and a deficiency of oxygen to give carbon monoxide and hydrogen.

SHEET AND TIN MILL EXTENSION, COLUMBIA-GENEVA STEEL DIV., U.S. STEEL CORPORATION, PITTSBURG, CALIFORNIA WORKS.—*Another one of the more than 11,000 successfully completed electrical contracting jobs engaged in by F&M in the past 35 years.*

Another Electrical
Installation by

FISCHBACH AND MOORE

INCORPORATED

"Proven Performer..."

Electrical contractors on the original construction of Columbia's Sheet & Tin Plate Mill in 1947 and 1948—proof of our performance rests in our being invited back in 1951 when Columbia undertook the expansion of its Sheet & Tin Plate Mill to nearly double its capacity and size.

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FROM COAST TO COAST *An organization that has to its credit every conceivable type of electrical installation.*

COMPLETE ORGANIZATIONS AT: *New York, Atlanta, Dallas, Houston, Los Angeles, San Francisco, Detroit, Chicago, Pittsburgh.*

How LINDE SERVICE* REDUCES THE COST OF OXYGEN

Surface scale and cracks must be removed from steel slabs and billets before they are rolled. Years ago that was a serious bottleneck in steel production.

In 1930 LINDE started to break this bottleneck with the introduction of oxygen scarfing. By 1945 the cost of scarfing had been reduced by LINDE-developed improvements to a fraction of former costs.

And yet, although other operating costs increased, LINDE SERVICE still found ways to reduce scarfing costs. By 1951—through additional improvements in technique and equipment—costs had been cut below those of 1945 by another 20%.

SAVING A MILLION DOLLARS PER YEAR!

In one operation alone, the hand-scarfing of slabs, LINDE customers are today realizing savings of more than a million dollars a year, over and above the already greatly reduced costs of just a few years ago. These savings result from current LINDE SERVICE. Significantly, they closely match the total cost of the oxygen for the operation. Regardless of the amount of oxygen you need—or the industry in which you use it—find out how LINDE OXYGEN plus LINDE SERVICE can help you save time and money.

* **LINDE SERVICE** is the unique combination of research, engineering, and over 40 years of accumulated know-how that is helping LINDE customers save money and improve production in their uses of oxygen and oxy-acetylene processes.

Linde Trade-Mark

LINDE AIR PRODUCTS COMPANY
A Division of UNION CARBIDE AND CARBON CORPORATION
30 East 42nd Street UCC New York 17, N. Y.
Offices in Principal Cities
In Canada: Dominion Oxygen Company, Limited, Toronto

Carbon monoxide, except as used in the manufacture of ethylene glycol and certain other products, will be reacted with steam to give hydrogen and carbon dioxide, which are readily separated. Hydrogen and nitrogen, the latter obtained in the production of oxygen from the air in separate equipment, will be used in making ammonia.

The bulk of the ash will be drawn off as slag, and light-weight particles will be caught in filtering equipment.

BEGIN WORK ON BUILDING TO HOUSE GIANT PRESSES

▲ The heavy press program stepped into high gear as ground was broken for the building to house two massive forging presses. The presses are part of the Air Force's defense program and are of 35,000 ton and 50,000 ton capacity.

The new building will be located adjacent to Aluminum Co. of America's Cleveland Works, where Alcoa maintains large aluminum and magnesium forging facilities.

The ground breaking was to take place without fanfare with huge earth moving machinery moving onto the site and begin grading and clearing the more than 26 acres of land for the buildings, railroad and yard areas.

In all, about 160,000 cu yd of earth will have to be moved to make ready for the buildings. Most of the earth will be used on the site for fill.

The main building will be more than 100 ft high over the press bay and will have approximately 532,000 sq ft of area under roof, about 12 acres. This is more area under roof than six complete football fields.

The outside measurements of the building will be 1,083 ft long and 480 ft wide. A boiler house of 100 ft by 80 ft and an outside die storage area 200 ft by 80 ft will adjoin the larger structure.

It is estimated that 13,000 cu yds of concrete will be used in the building foundation with the press foundations and other uses bring the total cu yds of concrete to 53,000. This would be enough concrete to make solid concrete foundations for more than 1300 homes.

To support the heavy presses and the plant, almost 17 miles of steel piling will be sunk 70 to 100 ft to bedrock. Each pile will be of 10¾ in. diameter pipe, filled with concrete.

The building, scheduled for completion near the middle of next year, will be constructed of a steel framework covered with corrugated siding with corrugated transparent plastic instead of windows. Concrete work is to begin a week from today with both presses scheduled for operation by January 1955.

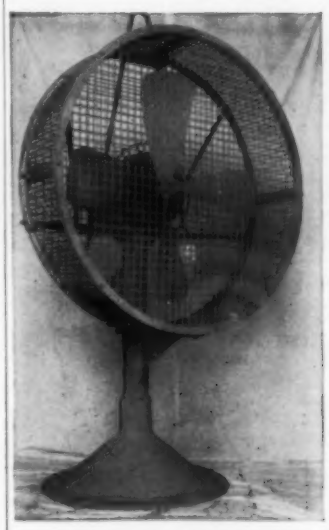
The total cost of the plant will be about 40 million dollars, with the company spending several additional millions on supporting facilities necessary to the operation of such mammoth equipment. Alcoa expects to lease from and operate the presses for the Air Force. With these two presses it will bring to three the number of such forging presses in Cleveland.

The presses were designed by two Pittsburgh firms — the 50,000 ton press by Mesta Machine Co. and the 35,000 ton press by United Engineering and Foundry Co.

IS HEAT SLOWING UP YOUR WORKMEN?

TRUFLO CRANE CAB FANS
For cooling interiors of crane cabs and other confined areas. Adjustable both horizontally and vertically. Four blade type, 12 and 18 in. sizes.

Keep them COOL with TRUFLO FANS



TRUFLO PORTABLE COOLING FANS
Easily portable. Help keep efficiency high where work is hottest. 12 to 36 nch diameters.

Production suffers when workmen are overheated. Steps begin to drag, efficiency falls.

Now, when speedy production is vital, Truflo Fans can help keep your workmen on their toes. All Truflo Fans are designed and built correctly to put fresh cool air *in large volumes* exactly where it is needed. Perfectly-balanced shafts and blades give more air per h.p. . . . strong steel frames stand up longer under hard use . . . rugged wire guards protect men against injuries.

All of the following types can help beat the heat, keep production moving in your plant. Write for illustrated literature.

PORTABLE COOLING FANS
CRANE CAB FANS • WALL FANS
EXHAUST FANS • BLOWERS
ROOF VENTILATING FANS
PENT HOUSE FANS

TRUFLO FAN COMPANY

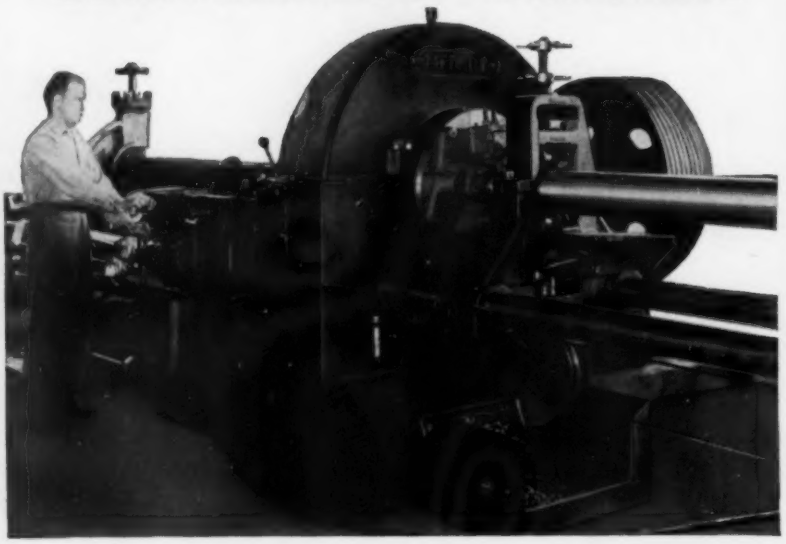
245 MAIN ST, HARMONY, PA.

Fully Automatic
Centerless Turning & Peeling!

. . . for bars and tubes from
1" to 9" diameter, and larger

MEDART

MODEL RFRG
CENTERLESS TURNER



- For high production superior finish, close-tolerance turning or rough peeling. Workpiece size and throughput speeds are limited only by capacity of cutting tools.
- New direct-drive roll-feed with patented Universal Centering Device insures continuous, positive feed and automatic centering of workpiece in cutterhead.
- Separate variable drives for feed and cutterhead give exact ratios between cutter speeds and bar feeds.
- Either 1 or 2 removable cutterheads may be used, with from 1 to 10 cutters for maximum cutting flexibility. Either carbide or high-speed tools are used.
- Eliminates time lost in loading and unloading. Automatic input and output grip carriages permit constant end-to-end feed and delivery.
- Fully automatic push button control from central operating station.

Write For Illustrated Brochure

THE MEDART COMPANY 3535 DE KALB STREET ST. LOUIS 18, MISSOURI

SPRING-CENTER WIRE ROPE DEVELOPED BY J & L

▲A new principle in wire rope construction, which engineers believe will solve a 50-year-old problem in deep-well drilling, was announced by Jones & Laughlin Steel Corp.

The new principle employs the ability of the coiled spring to flex and to resist crushing. The result: a wire rope with a core that is a coiled steel spring. No wire rope previously manufactured has employed this principle.

Development of the new product, designed for use in rotary drilling rigs, was begun 10 years ago at J&L's wire rope division plant at Muncy, Pa., under the supervision of Peter P. Somerville, general manager of the division.

A new principle in wire rope construction is shown in this illustration. The principle employs the combined abilities of a coiled spring to flex and to resist crushing. These abilities are well known to anyone who has ever held a common screen door spring in his hand. The screen door spring is, of course, as flexible as a snake. And, further, although made of lightweight wire, a screen door spring cannot be crushed by the strongest hand. The developers of this new spring-center wire rope, Jones & Laughlin Steel Corp., are producing it for use in oil and gas well drilling and in the other industries which use millions of feet of wire rope every year.

The new rope is now in production at Muncy. The steel for the rope's strands, and for the spring center, comes from J&L's Aliquippa, Pa., works.

Spring-center wire rope is the second inovation in wire rope manufacture introduced by J&L in recent weeks. The first, announced on April 14, (see Iron and Steel Engineer, May, 1953, p. 132) was J&L plastic-core wire rope, which uses a core of solid plastic. This plastic-core wire rope was engineered for use in the cable tool method of drilling oil and

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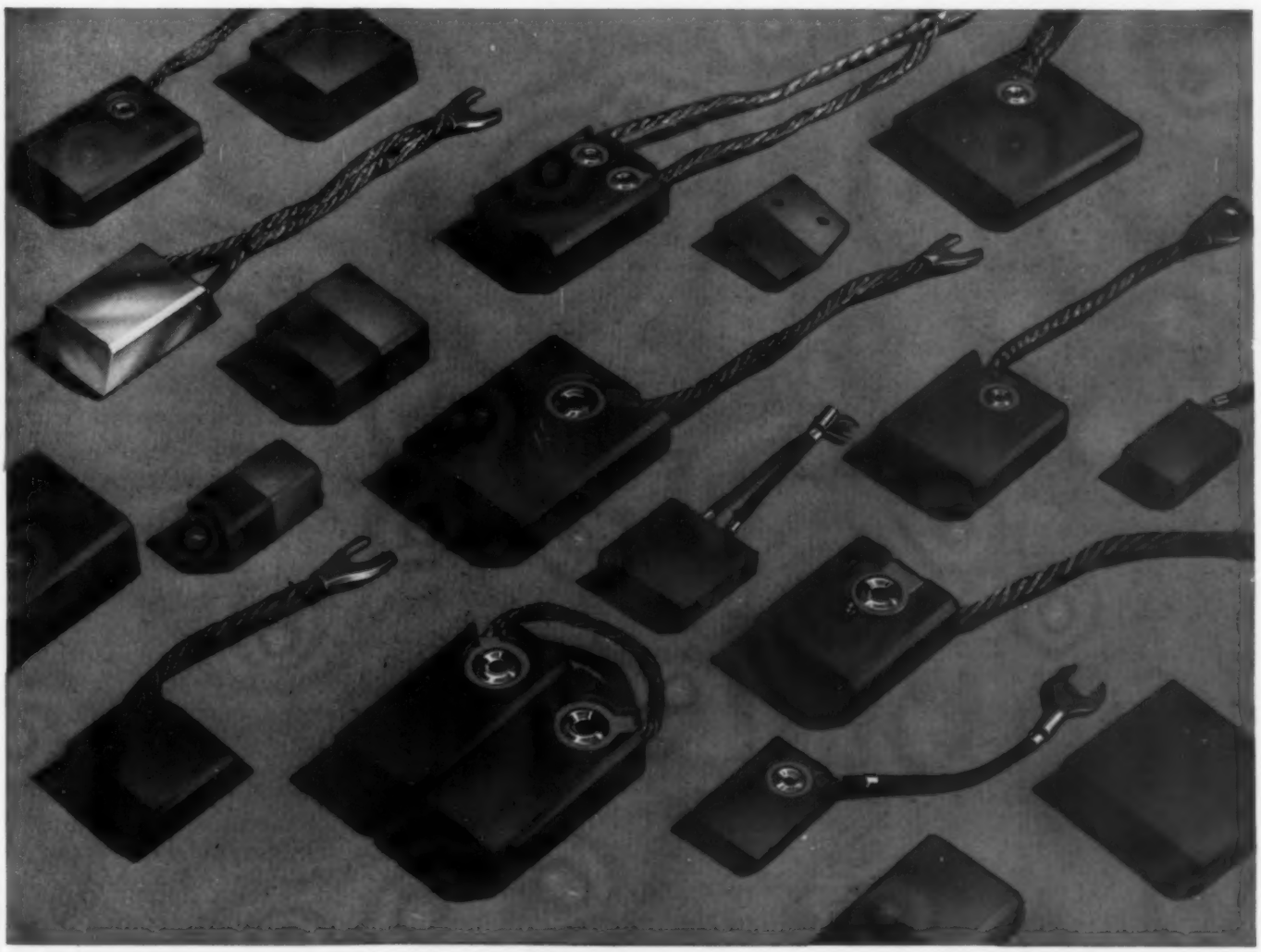
Try USG Brushes. They will solve those tough application problems for you. • Complete manufacturing facilities, plus continuous research and engineering make USG Brushes and Contacts the best you can use on all rotating electrical equipment. • USG BRUSHES can do a *better* job for you . . . Let us arrange a performance test to prove it.

Write today for 40-page catalog giving complete information on standard USG grades.



90-B

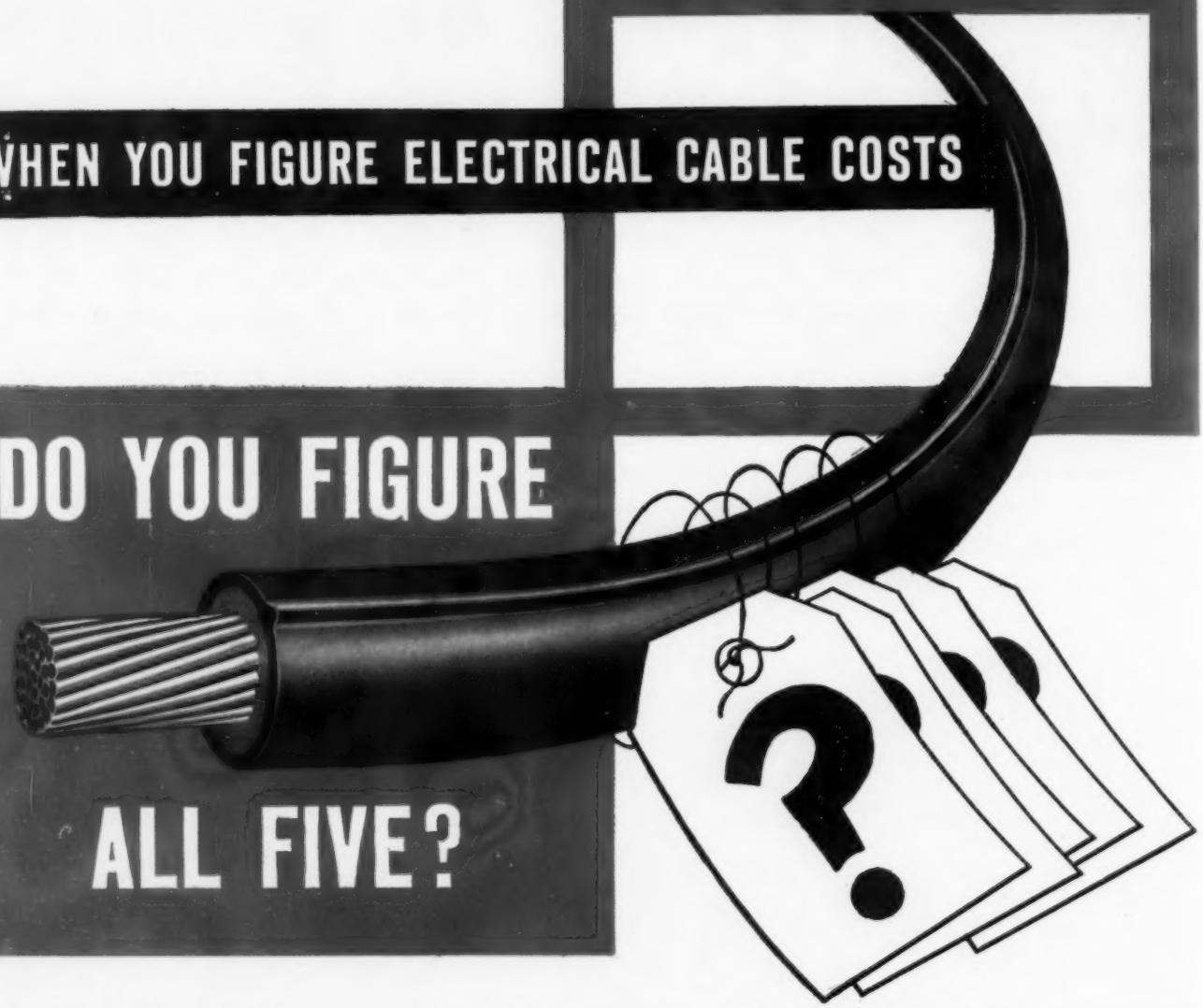
THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

WHEN YOU FIGURE ELECTRICAL CABLE COSTS

DO YOU FIGURE

ALL FIVE?



All too often electrical cables are purchased solely on the basis of initial cost. Actually, of course, this is only one of five factors to consider . . . and no true cost comparison can be made until the four "hidden" costs are figured.

Here are the four "hidden" costs which often upset your overall budget, particularly when you're trying to "economize":

- **installation costs**
- **maintenance costs**
- **costs of power shutdowns when a cable fails**
- **costs of replacing a cable which has failed prematurely.**

Okonite cables are the most effective means for combating these costs. A wide range of Okonite cable designs assures you of the most economical installation for any type of operating condition. And for savings throughout the life of the cable, Okonite always uses the premium materials and exclusive processing techniques which deliver unfailing electrical service year in and year out.

We can't condense millions of man-hours of cable research, field engineering and manufacturing experience into a short description of Okonite cables. But your Okonite representative can show you in black and white why the best cables — Okonite cables — really carry the lowest overall cost. The Okonite Company, Passaic, N. J.

The best cable is your best policy

OKONITE SINCE 1878 *insulated wires and cables*

gas wells. The spring-center wire rope was engineered for use in rotary drilling rigs.

TO ADOPT NEW VALUE FOR WATER VISCOSITY

▲ The National Bureau of Standards will adopt a new value for the viscosity of water on July 1, 1953. As a result of the research conducted by Messrs. J. F. Swindells, J. R. Coe, Jr., and T. B. Godrey, a new value of 1.0038 centistokes at 68 F has been established in place of 1.0070 centistokes at 68 F, the value currently in use.

Accordingly, extensive revisions to viscosity methods and tables will be required. The ASTM Committee D-2 on Petroleum Products and Lubricants is currently preparing the necessary revisions to the viscosity standards and tentatives affected. (D445, D466, D666 and D567.)

The National Bureau of Standards initially proposed to adopt this new kinematic viscosity value on July 1, 1952 but, at the request of Committee 4-2, granted a full year's delay in order to give proper publicity to the project and to give those concerned an opportunity to study the subject. Method D445-52T will be revised to cover the new adopted value on July 1, 1953.

Changes in viscosity measurements will be affected and changes in standards will be necessary. All kinematic viscosity measurements, for example, will be reduced by 0.318%. Saybolt Universal and Furol Viscosities, however, will not be affected. This means that viscosity conversion tables ASTM D-446 and ASTM D666 will require revision. The new tables will be available from ASTM headquarters after June 1, 1953.

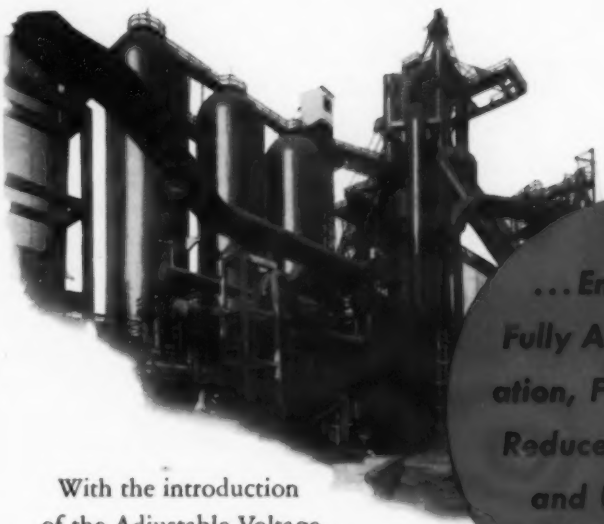
The table of basic kinematic viscosity values for computing Viscosity Index will also require changes. This table, found in ASTM Method D567, will be revised so that the Viscosity Index of a given oil will not change because of the adoption of the new standard value for water. Revised copies will be available after June 1, 1953. The table of basic Saybolt viscosity values for computing Viscosity Index will remain as at present.

Prepared booklets showing calculated Viscosity Indices for basic kinematic viscosity values similar to

MOHR

Announces...

THE ADJUSTABLE VOLTAGE DISTRIBUTOR CONTROL SYSTEM



...Engineered for Fully Automatic Operation, Faster Charging, Reduced Maintenance and Uninterrupted Production

With the introduction of the Adjustable Voltage Control Distributor Drive, Mohr makes another contribution to dependable blast furnace operation.

Through this advanced-type automatic charging system, distributor acceleration is stepped up and is quicker. Micrometer stopping is obtained with absolutely no drift. Motor speed is controlled in proportion to the angle of rotation, resulting in constant time of rotation, regardless of the angle, and in reduced operating time. Slower speeds at 60° and 120° rotations minimize wear of mechanical parts. The uniform time of operation and the simple adjustment of speeds of rotation are safeguards against the distributor restricting the skip hoist operation when emergencies require fast filling to bring up the stock line.

Write for complete details on this timely development.

Engineers Fabricators Contractors ...Since 1881

JOHN MOHR & SONS

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"IT'S THE GREASE FOR TOUGH OPERATIONS"

says McCULLOCH MOTORS CORP.
Makers of the famous McCulloch Chain Saws

"We tested all types and makes of lubricants for the Zerol gears in the transmission. The one grease selected for long, tough operation was LUBRIPLATE. Now that we have produced thousands of McCulloch Chain Saws, we more than ever recommend the use of LUBRIPLATE Lubricants in our tools."

For nearest LUBRIPLATE distributor, see Classified Telephone Directory. Send for free 56-page "LUBRIPLATE DATA BOOK"... a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

those issued by the Standard Oil Development Co., will also be revised to provide for the new values and will be available at ASTM headquarters later this year.

All kinematic viscometers in use will require restandardization or recalibration. Kinematic viscometers which have C-constants that are not simple numbers (i.e., 0.1, 0.3, 0.5, etc.) may be restandardized or recalibrated merely by multiplying their present factors by 0.99682 (or $\frac{1.0038}{1.0070}$). However, a more complicated procedure will be required where the C-constants are simple numbers, since the physical dimensions control the value of C and any one or all of the dimensions may have to be adjusted, if it is desired to retain the simple number C-constant.

The value of secondary standard oils in use by laboratories will also have to be reduced by 0.318 per cent. The National Bureau of Standards will revise the values of the viscosity standard oils they distribute as of July 1, 1953. In addition, the American Petroleum Institute viscosity standard oils alpha, beta and gamma will have their viscosity values revised as of the same date. Any standards on hand received prior to July 1, 1953 should have the values on the labels reduced by 0.318 per cent to conform to the adopted value.

In summary, then, the following will be established as of July 1, 1953:

1. The kinematic viscosity of water at 68 F will be 1.0038 centistokes.
2. All kinematic viscosities will be reduced by 0.318 per cent.
3. All kinematic viscometers will require restandardization or recalibration.
4. No changes will be required in Saybolt viscosities or viscometers.
5. Present conversion tables showing kinematic viscosity to Saybolt universal and Furol viscosities will be invalidated. Corrected tables will be available at ASTM headquarters after June 1, 1953.
6. Present basic kinematic viscosity values for computing viscosity indices will be invalidated. Corrected tables may be obtained from ASTM headquarters after June 1, 1953.
7. All secondary standard viscosity oils will require restandardization. For further information, contact ASTM headquarters.

ORDNANCE COMMENDS NATIONAL TUBE OUTPUT

▲Expansion from stand-by status to a heavy-weight ordnance producer in 34 months won Christy Park Works of U. S. Steel's National Tube Division the commendation of Brigadier General Merle Halsey Davis, special assistant to the chief of Army Ordnance, at a plant ceremony on May 5 when he accepted the 10,000,000th ordnance piece produced at the plant since Korea.

John E. Goble, president of National Tube Division, and William Fader, general superintendent of the plant, stood by as Mrs. Elizabeth K. Geary, an inspector on the production line, presented the 10,000,000th piece — a 90-mm shell — to General Davis.

Following the ceremony, General Davis inspected the defense production facilities with members of his staff, Mr. Goble, Mr. Fader, Pittsburgh Ordnance officials, and newsmen where the party saw steel tubing transformed into finished bazooka rockets on the 3.5-in. rocket lines, and saw steel billets transformed by hot forging and machining into finished artillery projectiles.

Christy Park works was a major source of bomb bodies, shell forgings, rockets and other ordnance items during the second World War, producing 26 million pieces of ordnance from June 1940 until June 1945. Munitions production was sharply

Mrs. Elizabeth K. Geary, 90 mm shell inspector at Christy Park works of U. S. Steel's National Tube Division is shown counting out the 10,000,000th ordnance piece produced at the plant since Korea. Assisting Mrs. Geary in her selection is Emmett Thomas, general foreman at the plant.

16 Years on the Job

. . . *still going strong*

. . . a pleasing record but not unique for users of Morgoil Bearings. Long life, of course, is a desirable attribute. But perhaps more important to you is the accuracy of rolling that Morgoils permit . . . the savings in power . . . the almost complete freedom from maintenance costs.

Whatever you are looking for in a roll neck bearing you will find it in Morgoil—the preferred bearing of the world's largest producers.

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ROLLING MILLS - MORGOIL BEARINGS
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REGENERATIVE FURNACE CONTROL

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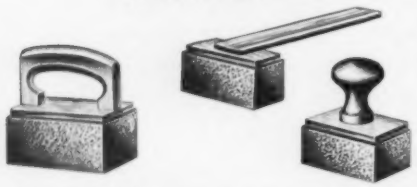
48"-72 Morgoil Bearings operating in 25½ and 52x90, 4 high hot strip mill at Granite City Steel Co., Granite City, Illinois.

MORGOIL
ROLL NECK BEARINGS

MARTINDALE

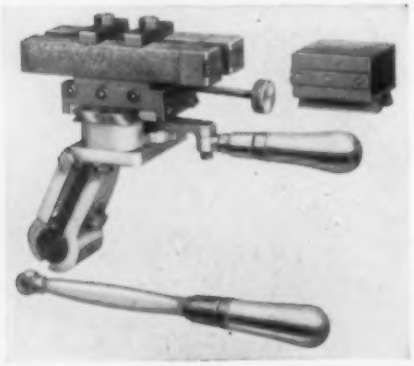
COMMUTATOR MAINTENANCE EQUIPMENT

COMMSTONES



Manually held Commstones made in a variety of sizes and with various handles. Eight grades available for proper resurfacing of commutators and slip-rings.

TYPE "C" COMMSTONE HOLDER



Holds Commstones rigid and true for concentric resurfacing of commutators and slip-rings while running at normal speeds in their own bearings. Grinds commutators up to 4¾" wide. Used with two Commstones in stone holder or one Commstone in 2" box.

MICA-MILLER UNDERCUTTER

A powerful, light-weight, low cost, easy to use Undercutter, operating from 1/5 h.p. Universal motor. Available with small, medium or heavy-duty head (interchangeable). Alsoavailable with air motor or flexible shaft drive.

Write for new Catalog No. 29 of Electrical, Industrial and Maintenance Equipment.

MARTINDALE ELECTRIC CO.

1331 Hird Ave. Cleveland 7, Ohio

reduced after World War II but since Korea has been rapidly expanded.

Engineers and maintenance men worked months to bring Christy Park to its present high operating rate. New production lines were designed and installed while old lines were reactivated, adapting World War II facilities to current ordnance needs. Employment has increased since Korea to 3200, of whom one-sixth, or 520, are women on the production lines.

DEVELOPS STRETCHER FOR AIRCRAFT PARTS

▲ Aircraft parts of the future will literally be pulled back into shape with the new 3,000,000 lb pull of a "stretcher" that is now being erected at Aluminum Co. of America's Lafayette, Ind., works.

The stretcher, owned by Alcoa, will work in conjunction with the nation's aircraft production program by straightening and relieving strain in large aluminum extruded parts. The parts will be made on either of two huge extrusion presses of 14,000 and 20,000 tons capacity at the Lafayette works as part of the Air Corps heavy press program.

Recently one of the two huge assemblies of welded steel plates that will form the bed of the stretcher arrived at the Alcoa plant.

This single piece of steel—largest ever to enter Lafayette—is 138 ft long and weighs 123 tons. Before the stretcher-column section could be moved from its fabricator near Philadelphia to Lafayette special transportation problems had to be overcome.

From Philadelphia it was shipped to East Chicago for machining. From the Chicago area the stretcher had to go hundreds of miles out of its way into Ohio and back another route to avoid as many sharp curves as possible.

The large piece of machinery was loaded on three railroad flatcars. Two of these were specially built 250,000 lb capacity flatcars and were arranged with a conventional flatcar between as a spacer. The shipment was permitted to travel only during daylight hours at 25 mph or under. It had a clear track all the way.

The complete stretcher will be about 180 ft long and about 5 ft wide with a total weight of about 2,100,000 lb. It will be capable of handling pieces of metal up to 110 ft in length and of straightening shapes up to 60 sq in. in cross-sectional area in one of the strongest aircraft alloys, 75S.

The 3,000,000 lb pull the machine can exert is equal to the pull of 38 large diesel locomotives. Extra safety allowances had to be built into the stretcher for if a piece of metal should break while under maximum tension it could fly off at 1900 in. per second or better than a hundred miles an hour. During the stretching period 17,000,000 in. lb kinetic energy is stored in the piece of metal. This tremendous force had to be absorbed in the stretcher itself in case of a break.

During the extruding process large pieces of metal have a tendency to warp or curve and in the process internal strains are built up. To guarantee freedom from these residual strains and to straighten the extruded part the strains and warps must be removed.

This is done by putting the extruded part into a stretcher and in a single operation overcome these difficulties. During the stretching operation the pull on the machine is so great that the stretcher-column may shorten as much as ⅜ of an in.

The stretcher is put on a foundation of 1500 cu yd of concrete that have 23 tons of steel reinforcing bars and 12 tons of steel floor plate. There are nine tons of aluminum tread pontoon bridge sections used for walks to provide working access to the machine.

This stretcher, designed by Alcoa engineers, is the largest known to be in existence and will have four times the force of any existing stretcher.

Together the extrusion presses with the stretcher will make possible larger—yet over-all lighter, more intricate aluminum parts for America's aircraft. During a peace time economy the transportation and building industries in general should benefit from the parts that will be made available from these huge machines.

G-E PLANS TRANSFER OF WELDING PLANT

▲ General Electric Co's. welding department located in Fitchburg, Mass., since 1946, will be transferred to York, Pa., by the end of March 1954, R. C. Freeman, general manager of the department announced recently.

He explained that the planned transfer will enable the welding department, and the company's small turbine and supercharger department which will remain in Fitchburg, to expand and thereby provide room for predicted increases in the business of both departments.

The welding department is scheduled to move into a newly vacated company plant at York, which will allow room for necessary manufacturing expansion. The plant formerly housed G. E.'s wire and cable division, which is being moved to two New England cities.

Mr. Freeman explained that General Electric's Fitchburg operation had reached its capacity with respect to the possible further expansion of the Welding Department's manufacturing facilities. When there are several G-E operations in the same plant and more space is needed, which is the case in Fitchburg, the tendency is to transfer the smallest or least compatible part of the operation to another city, making space available for local operation of the principal process or line of compatible products.

UNITED MARKS TENTH YEAR AT NEW CASTLE

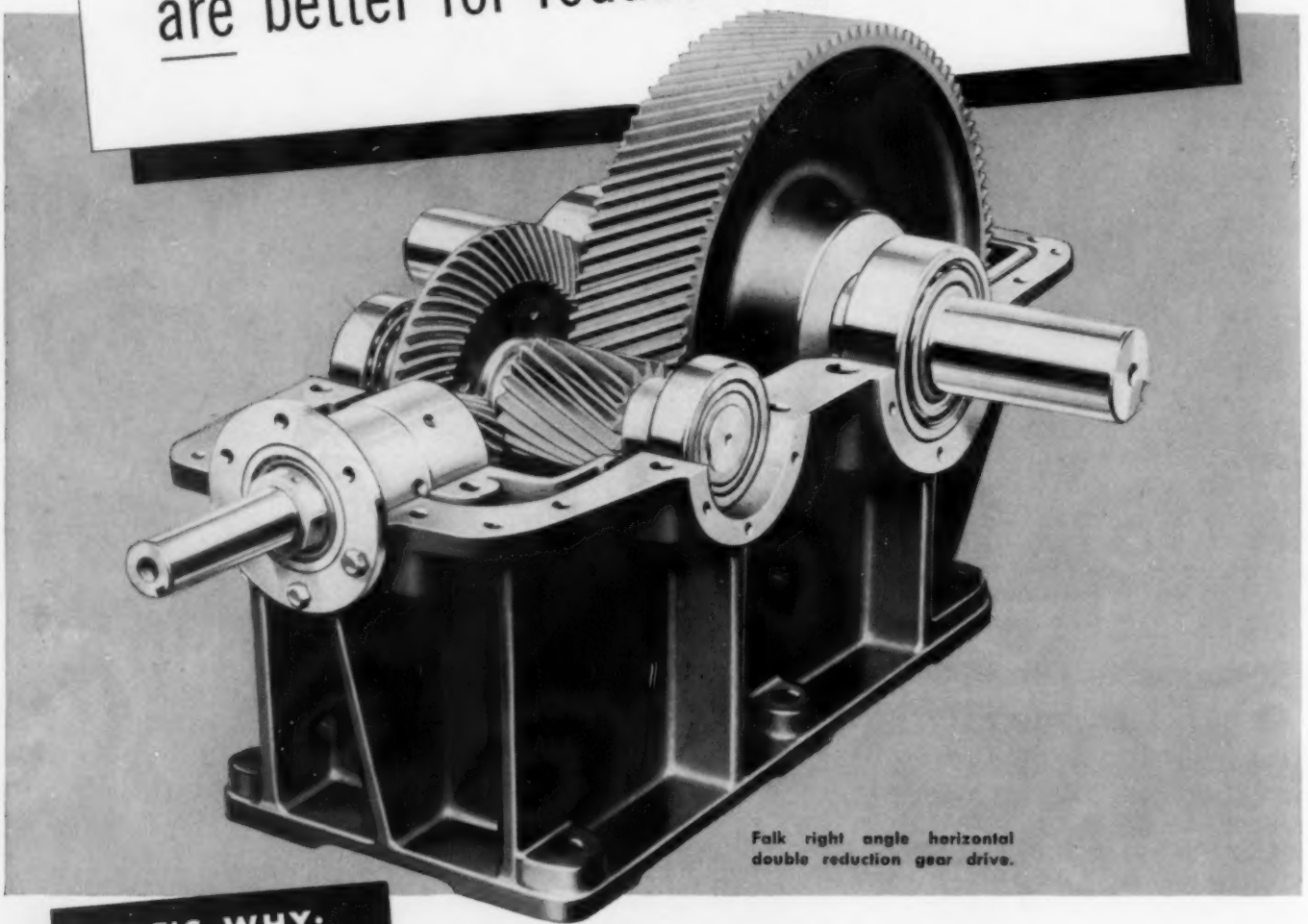
▲ The City of New Castle, Pa., joined in a municipal "Happy Birthday" to the United Engineering and Foundry Co. The New Castle plant of the company completed ten years of operation in that city and the occasion was marked on May 12, by an open house at the plant and a recognition dinner, at which time 683 employees who started with the company in 1943 were given ten year pins.

In 1942 United, on behalf of the Defense Plant Corp., took over the site formerly occupied by the New Castle plant of the U. S. Steel Corp. This plant had been demolished, save for a few buildings and the area was a depressing picture of broken concrete foundations with ragged steel remnants sticking out.

By October the plant was sufficiently finished to permit the first pour of steel from one of the open hearth furnaces. By April 1943 the plant was completed and machining work was started. At the time of its opening the plant was said by foundrymen to be the finest plant of its kind in the world.

Proved!
"In the Plants of a Large Canadian Steel Producer"
MESTA
ON RUN-OUT TABLES TOO..
LOVEJOY L-R
FLEXIBLE COUPLINGS
THREE YEAR
MAINTENANCE-FREE
SERVICE RECORDS
Eliminate costly shut-downs and break-downs due to coupling failures on run-out tables and other equipment with Lovejoy Flexible Couplings. They are designed to correct mis-alignment without vibration, backlash or surge. Free-floating load cushions are suspended between heavy metal jaws. No shut-downs for changing cushions, which last two to five years. No lubrication ever needed.
WRITE FOR COMPLETE CATALOG AND QUICK-FINDING SELECTOR CHARTS
LOVEJOY FLEXIBLE COUPLING CO.
3093 WEST LAKE STREET CHICAGO 44, ILLINOIS
Also Mfrs. Lovejoy Universal Joints and Lovejoy Variable Speed Transmissions

Yes, GULF E. P. LUBRICANTS are better for reduction gear drives:



Falk right angle horizontal double reduction gear drive.

HERE'S WHY:

1. **Good anti-weld properties**
2. **Noncorrosive**
3. **Extra tacky**
4. **Stable**
5. **Good rust preventive properties**

For cooler running gear drives, freedom from scoring caused by faulty lubrication, and for protection against corrosion, select Gulf E.P. Lubricants for your speed reducers and increasers.

Gulf E.P. Lubricants provide better tooth protection. And it is often practical to use a Gulf E.P. Lubricant of lower viscosity than is possible with a straight mineral oil, which may mean that fewer grades of gear lubricants are required.

For additional information on these superior gear-drive lubricants, send the coupon below.

GULF SERVES INDUSTRY

Gulf Oil Corporation • Gulf Refining Company
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Please send me, without obligation, a copy of your pamphlet "Gulf E.P. Lubricants for Rolling Mill Gears."

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Company.....

Title.....

Address.....

The plant has been one of the mainstays of the economic life of New Castle. Presently it is employing about 2100 men and women. In 1952 the payroll amounted to $10,400,000. The largest castings ever turned out in the history of the foundry business have been made here, weighing over 450,000 lb shipping weight.

Products manufactured in the plant are blooming, slabbing, plate, universal and four high strip mills. Continuous billet, bar, rail, and structural, and continuous rod mills are produced. Other products include steam and hydraulic forging presses, electro-hydraulic presses, extrusion presses, heavy weldments and castings and auxiliary equipment for steel mills.

TO INSTALL NEW TYPE INGOT HEAT PROCESS

▲ Barium Steel Corp. recently announced another step in the modernization and expansion program of Barium's steel producing plants. A completely new type of ingot heat processing installation has been contracted for with the Selas Corp. of America, and will be ready for production operation at Phoenix Iron & Steel Co., Phoenixville, Pa., a subsidiary of Barium Steel, by November, 1953.

Cooperative tests made during the past few months by Barium and Selas have proved the feasibility of various and unique patent protected features and methods involved in this important development. The new ingot heating process will not only reduce processing time to a fraction of present conventional ingot heating methods, but also will substantially reduce equipment and space requirements. The result will be reduced operating costs and appreciably lower capital investment per ingot ton.

WESTINGHOUSE PLANS ATLANTA INSTALLATION

▲ A new plant for the manufacture and repair of electrical equipment will be built in Atlanta, Ga., by the Westinghouse Electric Corp., it was announced recently. Power transformers, control, and switchgear will be the main products handled by the new plant, scheduled for completion in early 1954.

Otis O. Rae, manager of the south-

KEEPING CLOSE WATCH ON
A Suburb of Hell
UTILISCOPE
(Above) Inside of boiler furnace with temperatures up to 3000°F as SEEN by the "Utiliscope" camera.
Again
DIAMOND
"UTILISCOPE"
(WIRED TELEVISION)
Gives Eyes to Instruments
Operator watches "Utiliscope" screen to check furnace conditions.
The interior of a big power boiler . . . white hot with flaming powdered coal or fuel oil . . . can't be looked at conveniently. This "suburb of hell" is too hot and too brilliant for the human eye to watch continuously.
But it needs continuous watching. Only VISION can ride herd perfectly on the varying conditions of the raging flame . . . give a "sense of reality" to the control operator. There are plenty of instruments but they can't see.
At the Port Jefferson Power Station of Long Island Lighting Co., each furnace has a "Utiliscope" that looks directly into the fire. On a viewing screen in the centralized control room, the operator can SEE conditions that help in eliminating smoke. He can SEE that the ignition torches are operating satisfactorily before admitting pulverized coal or fuel oil. He can also SEE when ignition takes place during lighting off. On low load operation, he can SEE the stability of the flame.
Many processes and operations in industry need close observation for safe, accurate, and efficient control. But often they are too remote, too inaccessible, too hot, too cold, too dangerous, etc. for direct eye observation. The "Utiliscope" can watch these things . . . bring the image where it is needed. Write for bulletin containing suggestions.
• TYPICAL USES — Studying destructive tests of engines • Watching flow of molten steel • Checking remote gauge readings • Viewing nuclear research Coordinating materials flow on conveyors • The "Utiliscope" (Registered U. S. Patent Office)
6062
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LANCASTER, OHIO • OFFICES IN 39 PRINCIPAL CITIES
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Since 1903, Diamond has Manufactured Quality Equipment for Industry

eastern district for Westinghouse, said that construction of the modern steel and brick building represents the first phase of a multi-million dollar expansion in Atlanta. The expansion was dictated by the firm's recognition of industrial potentialities in the Southeast and by industrial growth already characterized by increased use of electric power. To date, Westinghouse has placed important plants in mine locations in the southeast.

Mr. Rae pointed out that the new building in Atlanta will provide facilities to enable Westinghouse to coordinate and bring under one roof office and factory personnel currently working in separate locations. The plant will be located on a 17-acre site at the corner of Chattahoochee and Ellsworth Avenues.

"Our plans for the next few years," he said, "call for a doubling in size of the new plant with provision for even further expansion later. Ultimately, we expect to occupy the entire 17-acre plot with office and factory facilities."

The Westinghouse executive said the new plant will be used not only to provide better office space for sales, engineering and other departments, but also more efficient manufacturing facilities. He pointed out that Westinghouse was the first, and at present is the only, manufacturer of power transformers in the Southeast.

Further emphasizing the need for these larger facilities, Mr. Rae said that current company manufacturing and repair business in the Southeastern District has increased approximately 10 times in the past 10 years, and that the outlook for the future calls for a constant increase in our production facilities.

REBUILT BATTERY 15 PUSHES FIRST COKE

▲Clairton's newly rebuilt No. 15 battery pushed its first coke May 13, becoming the third rebuilt coke producer to start up at the U. S. Steel plant since January 1.

Constructed by Koppers Co., Inc., the gun-flue type battery uses self-sealing doors and double collecting mains. It will convert 1400 tons of coal daily into 966 tons of coke while producing coal chemicals and other substantial quantities of by-products.

The coke, an essential iron making ingredient, will feed Pittsburgh, Pa., district U. S. Steel blast furnaces.

Coke oven gas, a major by-product recovered in the coking process, is piped to U. S. Steel mills where it fires open hearth and reheating furnaces.

The newly-rebuilt unit's 61 ovens bring to 183 the total number of ovens modernized and put into operation at Clairton, Pa., works this year.

ANNOUNCES PURCHASE OF FULLER JOHNSON CORP.

▲ Clark Controller Co. announces the acquisition by outright purchase of Fuller Johnson Corp., a company which in turn owns and operates American Electric Switch Corp., and Good Roads Machinery Corp., all of Minerva, Ohio.

American Electric Switch manufactures safety switches and electric service entrance equipment, and will continue to make these items, none of which are made or sold at present by Clark Controller Co. It is not now intended that Electric Switch will make or sell any apparatus made by Clark.

Good Roads Machinery makes a line of road machinery accessories.

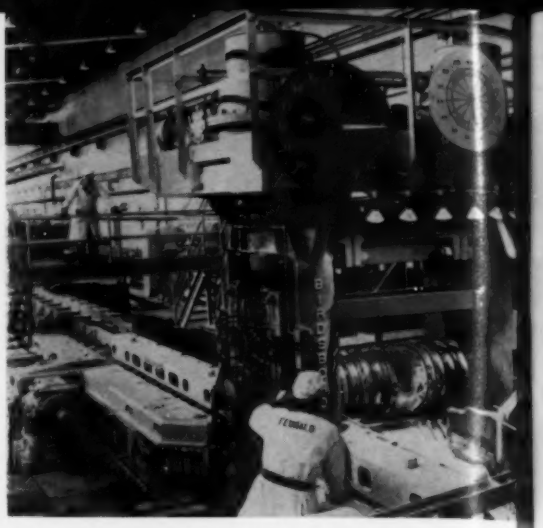
The sales organizations and distributors of both firms will be maintained as at present. Clark will further the sales of Electric Switch products through its own sales and distribution set-ups in areas where Electric Switch is not at present represented.

The Minerva firms have adequate backlogs of government orders for mechanical controls for army tanks, and will continue the manufacture of such items.

Seventy-five thousand sq ft of manufacturing and office space are located on 15 acres of ground in Minerva, and will continue to be used as their manufacturing facilities by approximately 500 employees. Clark will provide these companies with wider engineering facilities, and will broaden the present sales areas.

URANIUM ROLLING MILL BUILT BY BIRDSBORO

▲The first and only mill in the country designed expressly for the production rolling of uranium was put into operation at Fernald, Ohio, recently for the Atomic Energy Commission.



This primary mill, followed by a continuous finishing mill, is used to roll uranium into bars for further fabrication into slugs used in nuclear reactors.

Operations at the new A E C uranium rolling mill are now playing a vital role in the defense production of atomic weapons. The mill, designed and built by Birdsboro Steel Foundry & Machine Co., of Birdsboro, Pa., is part of the Commission's new uranium production center at Fernald. This center produces uranium for use in A E C fissionable materials plants throughout the country and is operated for the A E C by the National Lead Co. of Ohio.

To meet the exacting requirements of this job, Birdsboro had to solve a host of tough engineering problems. The company's engineering staff spent month after month in research and experimentation.

Birdsboro started at the ground level to build a mill that could roll uranium ingots into bars in production quantities. Today the A E C mill is in steady, high volume production.

EXPANSION PROGRAM NEARS COMPLETION

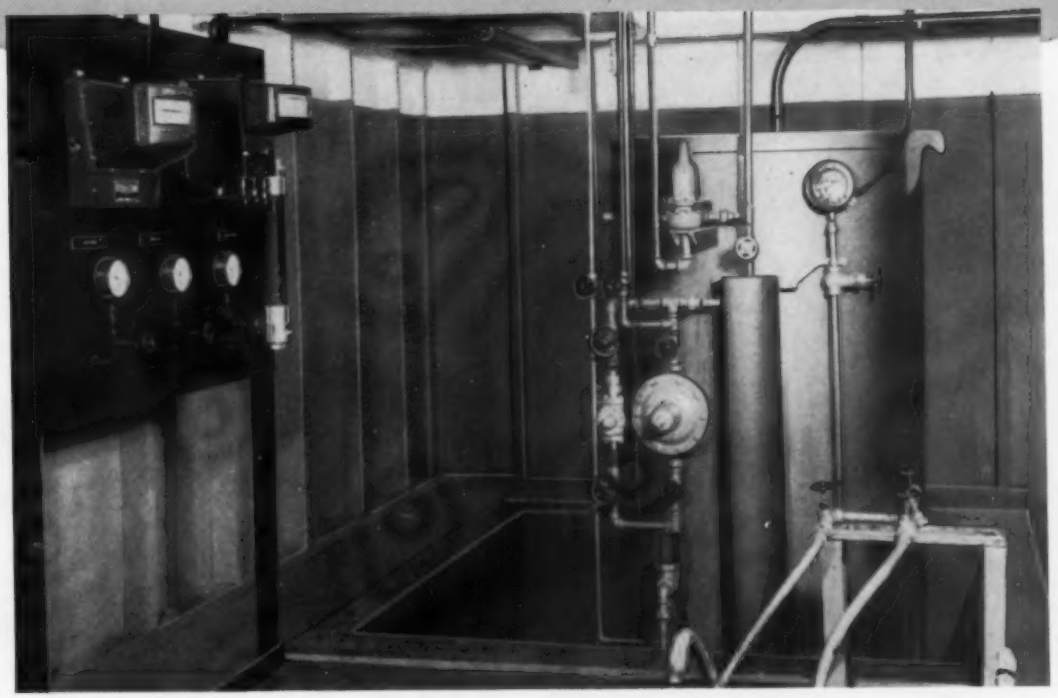
▲ A $200,000 expansion and shop rearrangement program for increased production efficiency is nearing completion in the Emmaus and Allentown, Pa., plants of Air Products, Inc. The company manufactures oxygen-nitrogen generators and equipment employing extremely low temperatures used in the steel, glass, chemical and petroleum industries.

The test department has been moved to a new location in the Emmaus plant. In the future all large generators will be assembled, tested, painted and shipped from there. A T-shaped pit, 20 ft deep, 16 ft wide,

DREVER

AMMONIA DISSOCIATOR

produces **the ideal protective furnace atmosphere**



Shown at right is Drever 1000 CFH Ammonia Dissociator — panel complete with flow meter, pressure gauge, over-temperature protection instruments and temperature control, which is now furnished flush mounted.

"CRACKED" AMMONIA SHOWS TREMENDOUS COST SAVING and UNSURPASSED PERFORMANCE

1 —Bright Annealing — Stainless Steels, Nickel and Nickel Alloys, Beryllium Copper, Silicon Copper Alloys and Bronzes, and high and low carbon steels.

2 —Clean Hardening — High carbon and high chrome tool steels.

3 —Copper Brazing of all types of ferrous metals.

4 —Sintering of Powdered Metal Parts.

5 —Reduction of Metal Oxides.

6 —Bright Annealing of Electrical Steels.

7 —Atomic Hydrogen Welding.

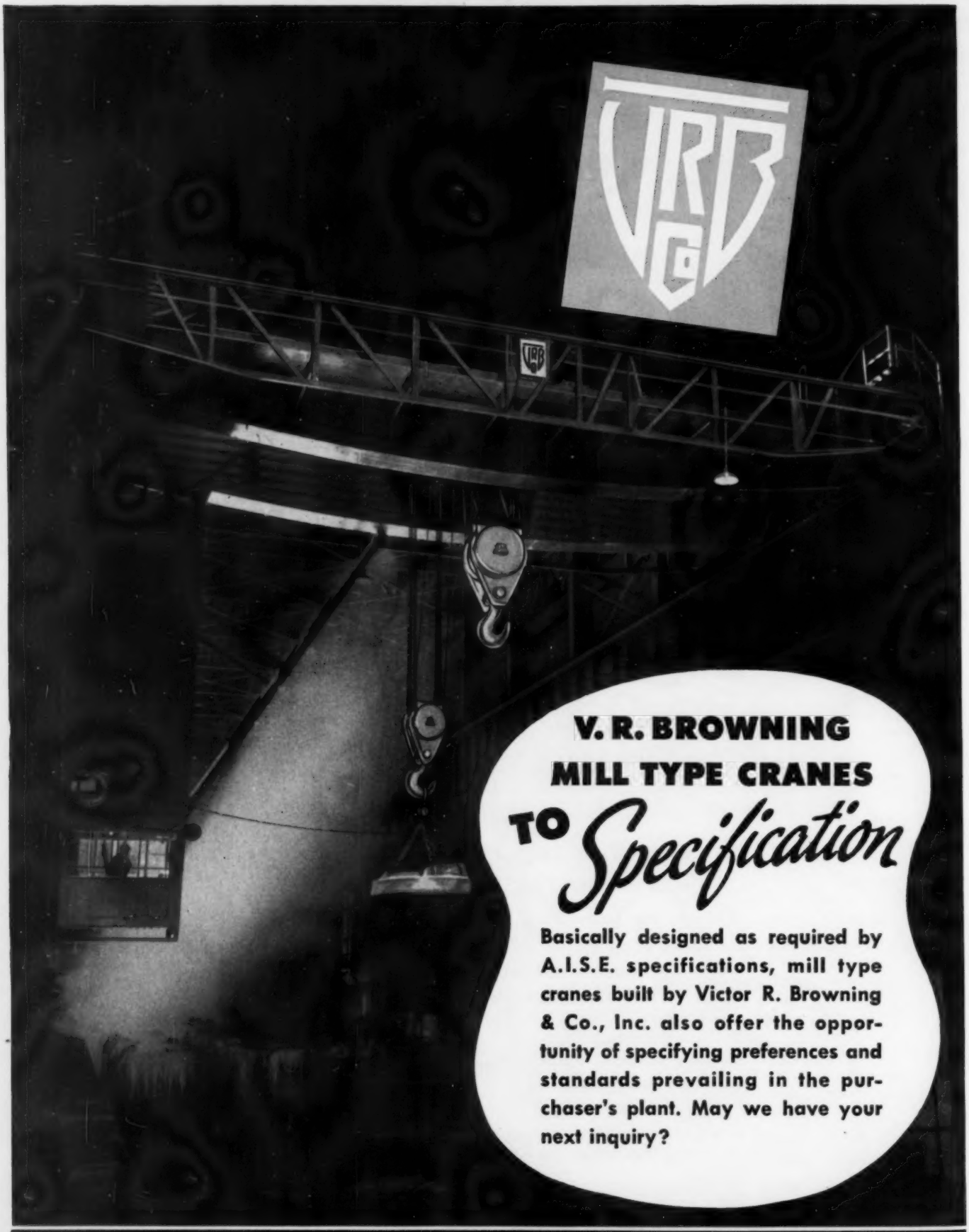
8 —Radio Tube Sealing.

We can supply COMPLETE STORAGE SYSTEMS for tank car lots of anhydrous ammonia. This reduces the cost of ammonia approximately 75%.

● **GET ALL THE FACTS** about dissociated ammonia, pure, dry hydrogen and nitrogen. **Write today for Bulletin B-52 now on the press.**

DREVER CO.

730 E. VENANGO ST., PHILADELPHIA 34, PA.


V. R. BROWNING
MILL TYPE CRANES
TO Specification
Basically designed as required by A.I.S.E. specifications, mill type cranes built by Victor R. Browning & Co., Inc. also offer the opportunity of specifying preferences and standards prevailing in the purchaser's plant. May we have your next inquiry?

VICTOR R. BROWNING & COMPANY, Inc.

BOX 309, WILLOUGHBY (CLEVELAND), OHIO

Designers and Builders of Electric Overhead Traveling Cranes and Hoists and Electric Revolving Cranes

and 52 ft long has been constructed for testing and experimental work. A new siding will connect the department with the Reading Railroad, giving the company two railroad connections. Under the rearrangement, the sheet metal and welding departments will also be more closely integrated.

New machinery and machine tools have been purchased for the welding shop, the sheet metal shop, and the machine shop in the Emmaus plant and for the assembly group in the Allentown plant. Heavier loads will be handled by new crane facilities in both the test department and the machine shop in Emmaus.

Meanwhile, the offices and engineering departments in both plants are being air-conditioned. Work will be completed by the end of the month.

Construction is also under way on the first unit of six in a new Air Products Laboratory on a 31-acre tract on the southwest side of Allentown. The laboratory is the first building to be erected under a program that has as its objective the consolidation of the company's activities, including manufacturing, on the site.

ESTABLISH INDEPENDENT RESEARCH LABORATORY

▲Announcement has just been made of the establishment of an independent laboratory, Cambridge Applied Research, Inc., located at 60 White Street, Belmont 79, Mass.

The new firm is prepared to place at the disposal of industry its highly-developed facilities — scientists who are specialists in their fields working with the newest technical equipment. The basic principles which underlie many of the amazing refinements and developments that will take place in the next decade are already known to solid state physicists and metallurgists. The company offers the knowledge and skill required to link these basic principles with the specific needs of industry.

The rapidly changing, highly competitive era that industry is now entering makes it imperative that businesses, to grow and prosper, continually improve their products. The scientists, technologists and other experts who have combined to form the new concern, have precisely this purpose—to aid in the continual improvement and development of industrial products.

GARLOCK PACKING CO. MOVES DETROIT OFFICE

▲The Detroit, Mich., office of Garlock Packing Co. has moved to new and larger quarters at 2781 East Grand Blvd., Detroit. At the same time, the status of the Detroit office was changed from that of a sub-branch reporting to Garlock's Cleveland office to that of a regular district office reporting directly to the main office in Palmyra, N. Y.

The Detroit district office under the direction of Edward M. Thomas, Jr., district manager, will serve the lower Michigan peninsula and the Indiana counties of Elkhart, Marshall, La Grange, St. Joseph, and Steuben.

HYDROPRESS TO BUILD PRESSES FOR REYNOLDS

▲Hydropress, Inc., New York, N. Y., has received an order for two self-contained oil-hydraulic extrusion presses from the Reynolds Metals Co., in Richmond, Va. These presses are of the latest design enabling this company to extend its extrusion operations. This decision by one of the major aluminum companies is another indication of the growing interest of the industry in the extrusion market.

RAILWAY TO EQUIP CARS WITH TIMKEN BEARINGS

▲The Quebec, North Shore and Labrador Railway has placed an order for 32,000 roller bearings with Timken Roller Bearing Co. Every ore car on its line, or a total of 2,000, 97-ton ore cars, will each be equipped with sixteen Timken bearings. The first road to equip one hundred per cent of its freight cars with roller bearings, the Quebec, North Shore and Labrador Railway is scheduled for completion in 1954.

Prior to receipt of the order for bearings, Timken conducted an exhaustive economic study which compared the costs of friction bearings with roller bearings. The study showed conclusively that roller bearings assured substantially longer service with much lower maintenance costs than did the friction type bearing. The results of this study assisted the Quebec, North Shore and Labrador Railway in its decision to select Timken tapered roller bearings for its iron ore cars.

Section of the 357-mile Quebec, North Shore, and Labrador Railway which will link the Labrador iron ore deposits with the St. Lawrence River. All 2,000 ore cars on the line will be completely equipped with roller bearings.

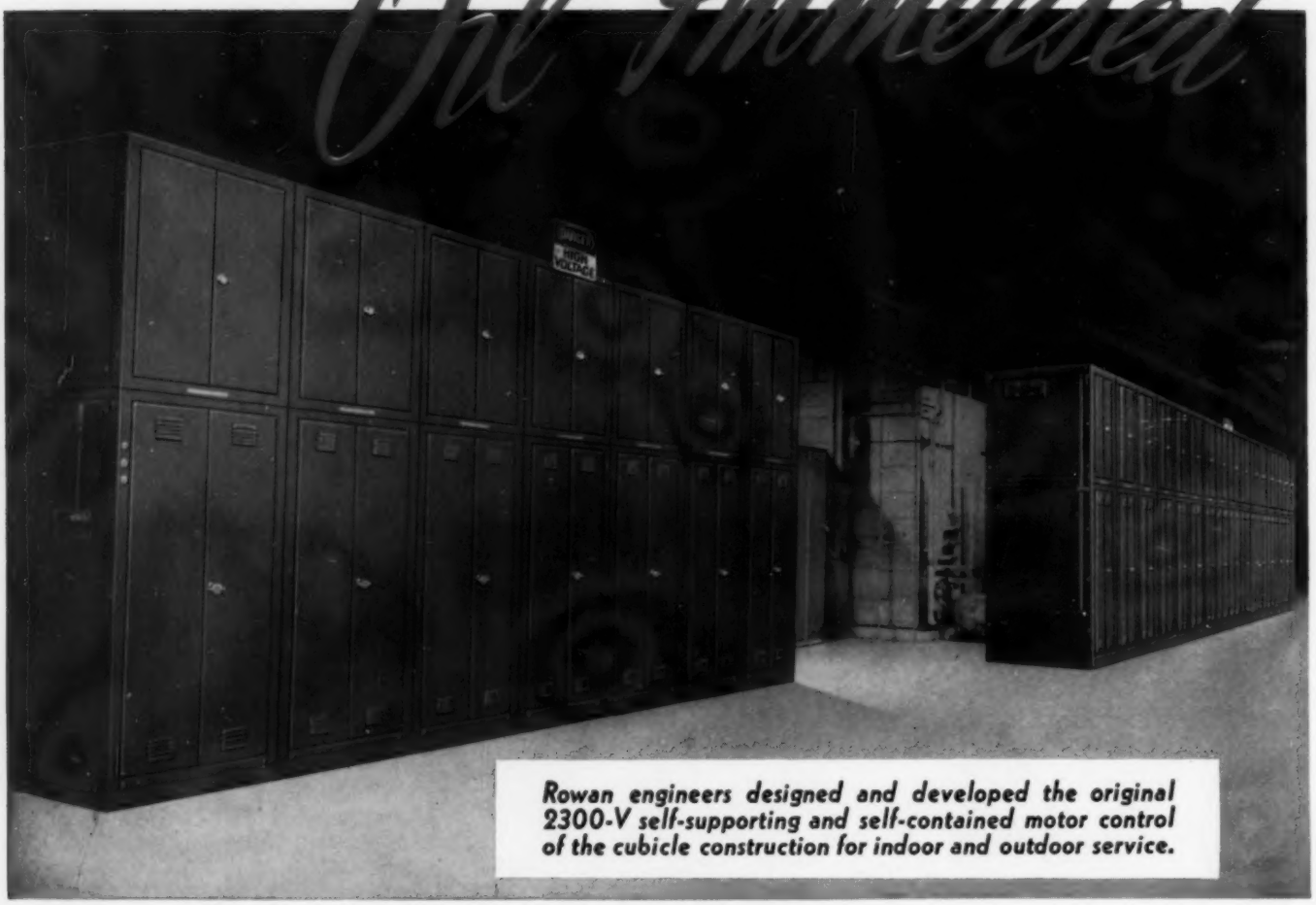
The railroad will extend 357 miles north from the St. Lawrence River at Seven Islands, Quebec to within only 850 miles of the Arctic Circle, through some of the roughest terrain on the continent of North America. The line will connect Labrador iron ore deposits, being developed by Iron Ore Co. of Canada, with the St. Lawrence River. Hollinger Hanna, Ltd., is the operating agent of Iron Ore Co. of Canada, a company comprised of the Hanna Coal & Ore Corp., Hollinger Consolidated Gold Mines, Ltd., National Steel Corp., Wheeling Steel Corp., Youngstown Sheet and Tube Co., Armco Steel Corp., and Republic Steel Corp.

Ore shipments from the Labrador field are expected to begin in 1954. By 1955 a production of 5 million tons is anticipated, and this production will be increased to ten million tons in 1956 or 1957. Long range plans provide expansion to an output of 20 million tons per year, if conditions warrant.

CONTINENTAL DIVISION NAMES REPRESENTATIVE

▲ Copes-Vulcan division of Continental Foundry & Machine Co., Erie, Pa., announces the appointment of Alan Moore & Co., 3091 Mayfield Road, Cleveland, Ohio, as representatives for Copes-Vulcan products.

Oil Immersed



Rowan engineers designed and developed the original 2300-V self-supporting and self-contained motor control of the cubicle construction for indoor and outdoor service.

Standard units consist of: a self-contained, insulated bus; a self-contained control potential transformer; current-limiting or high-interrupting capacity fuses; a specially designed, quick-acting, heavy-duty contactor with non-freezing contacts; sealed-off motor lead compartment; separate low-voltage control compartment; magnetic overload relays with electric reset, instantaneous and inverse time element — and a self-contained, tank lowering device.

Additional features such as watt-hour meter, voltmeter, ammeter, potential switch, etc., can be had to meet the requirements for specific applications.

Rowan sales offices are conveniently located throughout the country. A representative is quickly available to give you complete information.

ROWAN CONTROL

THE ROWAN CONTROLLER CO., BALTIMORE, MD.

Need an oil seal that's ideal for FLEXIBLE operation?...

Exhaustive tests by Ajax Flexible Coupling Co. showed that Clipper Seals met all 10 of these exacting requirements

THIS NEW AJAX DIHEDRAL COUPLING handles misalignment, hitherto considered impossible, between driving and driven machines. Because of its unusual design features, it was necessary for Ajax engineers to anticipate and set up rigorous qualifications for the oil seal that would safeguard the lubricants in the coupling. Clipper Seals were selected because they fulfilled *all ten* of the following *requirements:*

1. **A tight fit** on each gear hub, and proper contact with the inside diameter of housing.

2. **The ability** to stand up under constant flexing over a wide range of speeds.

3. **Sliding contact** with hub to allow free end float.

4. **Absolute retention** of lubricant to protect gear teeth.

5. **The dual function** of keeping the dirt out and the fluid grease in.

6. **Long life** to equal the long life of the coupling under severe conditions.

7. **Ability to withstand** normal running as well as increased ambient temperatures encountered in steel mills, foundries and processing plants.

8. **Performance unaffected** by operation in corrosive atmospheres, and by hosing down with water.

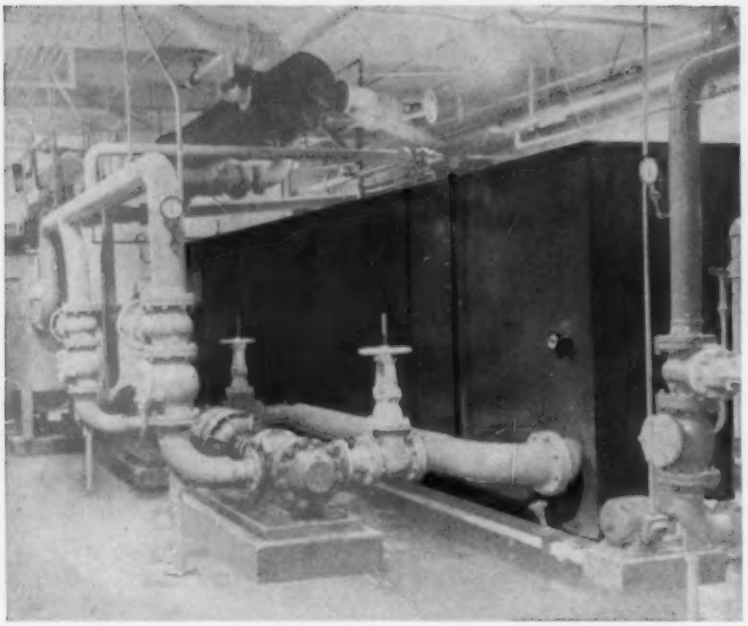
9. **A range of sizes** to meet the required sizes of the manufacturer.

10. **Convenience** of assembly and disassembly in the field.

Clipper Seals, day after day, are meeting new and arduous requirements set up by design engineers in almost every field. Their wide variety of compact designs, their precision moulding, and ease of installation have given them a high preference rating for almost any sealing condition on all types of equipment. For further details, address Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CLIPPER SEALS



When De Laval Designs Your Mill Lubrication System TANKS Are Important

When De Laval designs your mill lubrication system, even a part as simple to build as a tank is designed with utmost care. De Laval tanks are made of welded steel. They are fitted with baffles in such a way that lubricating oil is retained for a minimum of 30 minutes to give adequate settling.

Pumps draw oil from a point below the surface but not at the bottom of the tank, thereby allowing sludge and water to settle and remain quiescent on the bottom of the tank, to be removed by centrifugal purifiers or by draining the tank.

Tanks are constructed with heavy ribbing and supports that keep them from bulging. Adequate valves and connections are provided. Openings at the top of the tank are dust-tight. Even the paint, inside and out, is carefully chosen to afford maximum protection—the bottom, for example, is painted with asphalt paint to prevent rusting.

It takes no particular skill to design an adequate tank for a mill lubrication system. But as an example of the typical care given by De Laval engineers to detailing every part of such a system, even a tank becomes important.

● Send for Bulletin 500.

ALL DE LAVAL ENGINEERED MILL LUBRICATION SYSTEMS HAVE THESE SPECIFIC FEATURES:

1. Pipe Size Properly Selected
2. Lubricant Correctly Metered
3. Temperature Efficiently Controlled
4. Lubricating Oil Purified

For Large Mills:
Custom-built systems

For capacities up to 50 gpm:
The self-contained Unilube
(Available in four types)

THE DE LAVAL SEPARATOR COMPANY
Chicago POUGHKEEPSIE, N.Y. San Francisco
DE LAVAL SALES & SERVICE, INC.
447 Fourth Ave., Pittsburgh 19

De Laval ENGINEERED SYSTEMS

We Serve Steel

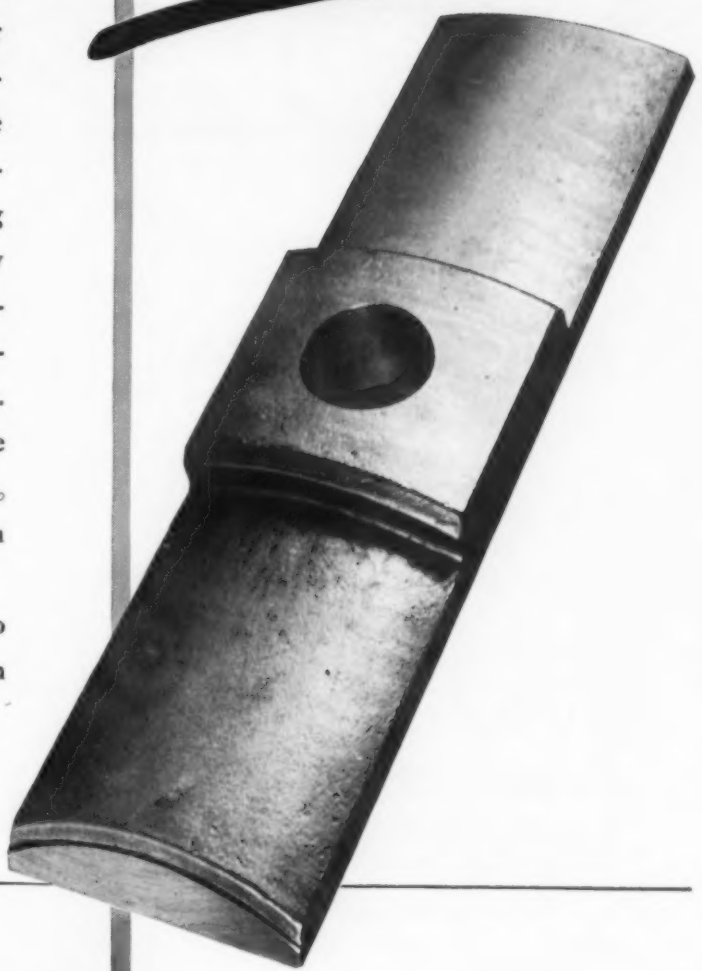
Knowing Copper Alloys

Better Best

We specialize in copper and copper-base alloys such as bronze. And we cast these metals for steel industry use by the most advanced methods. For example . . . this aluminum bronze slipper is made by our permanent mold technique and requires *no machining* after casting except for the pin hole. Oil grooves are actually cast-in. Surface hardness is completely controlled, and our customers realize dollar savings through our production-run economies.

National Bearing Division offers you the benefits of more than 50 years of experience, metallurgical research and production-run facility development.

Our 6 centrally located plants are ready to serve you. Contact National Bearing Division for full information.



A FEW NATIONAL BEARING STEEL INDUSTRY PRODUCTS: Bosh Plates • Monkeys • Tuyeres • Coolers • Mantel Plates • Stack Plates • Roll Neck Bearings • Housing Nuts • Babbitt Metals • Slippers

You're invited to visit us at our plant in Meadville, Pa. . . . We'll be glad to have you know us better.

AMERICAN Brake Shoe COMPANY

NATIONAL BEARING DIVISION

4936 Manchester Avenue • St. Louis 10, Mo.

PLANTS IN: ST. LOUIS, MO • MEADVILLE, PA. • NILES, OHIO • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

REFRACTORIES— Melting... Cutting Out...?

RUNOUT TROUGHS

CINDER NOTCH LINERS

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MOLD PLUGS

BEDS AND TRAYS

SPLASH PLATES

STOOL INSERTS

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Stock NATIONAL Carbon Brick and Shapes for Low-Cost Maintenance

"National" carbon blast furnace linings, of course. But HAVE YOU THOUGHT ABOUT CARBON for the other hot-spots where ordinary refractories conk out from high temperatures or slag-cutting? CARBON, the refractory, has no melting point and low affinity to molten metal and dross. In fact, even in *unfavorable* atmospheres, CARBON frequently outperforms other refractories on a length-of-life or cost-of-replacement basis.

Here are some of the places where "National" carbon and graphite can follow up their good work in the furnace...improve production, deflate maintenance cost, increase product quality and better the safety of equipment and personnel.

ON NEW APPLICATIONS OF CARBON, CONSULT NATIONAL CARBON'S ENGINEERS FOR PROPER GRADE AND DESIGN.

The term "National" is a registered trade-mark of Union Carbide and Carbon Corporation

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A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

District Sales Offices:
Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

IN CANADA:
National Carbon Limited — Montreal, Toronto, Winnipeg

Personnel News...

E. K. Miller has been named vice president of production for Jones and Laughlin Steel Corp., Pittsburgh, Pa. **Herbert Johnson** became vice president—administration, and **John B. Mitchell,** executive vice president of production, who retired June 1 under the corporation's policy of retirements, was named special consultant to the president. Mr. Mitchell will remain active in the affairs of the corporation and will continue as a member of J&L's board of directors, the executive committee, and the management committee. **Adam J. Hazlett,** executive vice president of distribution, becomes executive vice president of the corporation.

William Brill was appointed director of engineering for Colorado Fuel and Iron Corp., Pueblo, Colo. Mr. Brill has served as chief engineer for the Pueblo plant since February 1, 1950.

H. J. Macdonald was named general manager of the Buffalo, N. Y., plant of Hanna Furnace Corp. Mr. Macdonald succeeds **Charles Heist,** who is retiring. Mr. Heist, 65, has been with the iron producing firm since May 5, 1951, when he came to the Buffalo plant as general superintendent. He previously had been employed by the Standard Lime and Stone Co. and Youngstown Sheet and Tube Co. Mr. Macdonald has been assistant general manager at Buffalo since 1948. He joined the organization, a unit of National Steel Corp., as assistant general superintendent in 1941. He formerly had been employed by Republic Steel Corp. and Youngstown Sheet and Tube Co. **Earl C. Evans,** superintendent of maintenance, has been promoted to general superintendent.

Dr. Webster N. Jones, dean of the College of Engineering and Science at Carnegie Institute of Technology, Pittsburgh, Pa., has been appointed vice president in charge of industrial and government relations at Carnegie. Dr. Jones, who will be Tech's first vice president, will assume his new duties on July 1, 1953.

James A. Roemer and **John J. Kraus** were elected vice presidents of Sharon Steel Corp., Sharon, Penna. Mr. Roemer joined Sharon Steel in 1932. He has been the operating head of the Niles, Ohio, rolling mill division since its inception in 1935. Mr. Roemer is also president of the Mallory-Sharon Titanium Corp. Mr. Kraus joined Sharon Steel sales office in Detroit in 1937. After the war, he became vice president of sales of the company's Detroit seamless steel tubes division, and later, general manager of the Detroit tube and Steel division, as well as district manager of the Detroit district sales office of Sharon Steel.

L. E. Grubb, former general superintendent of International Nickel Co.'s Bayonne, N. J. works, has been appointed general superintendent of the Huntington, W. Va., works. At the same time, **P. H. Flynn,** who had been assistant superintendent of the company's Bayonne, N. J., works, was named general superintendent succeeding Mr. Grubb.

Edward L. Ryerson has retired as chairman of the board of Inland Steel Co., Chicago, Ill. **Clarence B. Randall,** formerly president, was made chairman while continuing as chief executive officer. **Joseph L. Block,** formerly executive vice president, was elected president. Mr. Ryerson will continue as a director and as chairman of the executive committee of the board. He had continued as chairman last year, when he became 65, only after the post was made "consultative and advisory" and the responsibilities of the chief executive were transferred to the president.

M. E. Marsh was appointed assistant vice president of Wheeling Steel Corp., Steubenville, Ohio. Mr. Marsh will be in charge of factories and will also serve as president of the Ackermann Manufacturing Co.

Raymond L. Walsh, assistant chief engineer of the Universal Atlas Cement Co., New York, N. Y., a U. S. Steel Corp. subsidiary, has been appointed chief engineer. Mr. Walsh has been importantly connected with the engineering and new construction program of the company for a number of years. He joined the company at Chicago in 1925 as assistant electrical engineer. In 1929, he became electrical engineer and was appointed

E. K. MILLER

JOHN B. MITCHELL

ADAM J. HAZLETT

WILLIAM BRILL

assistant chief engineer in 1944, which position he has held until the present time.

Harold C. Lumb was named general counsel for Republic Steel Corp., Cleveland, Ohio. Mr. Lumb succeeds **T. F. Patton** who is now assistant president and first vice president.

Bert Smith veteran official of Youngstown Sheet and Tube Co., has retired from active service after 48 years with the company and its affiliates. For the last 33 years Mr. Smith was works accountant at the Indiana Harbor plant. **Fred W. Jay,** assistant works accountant, has been appointed works accountant to succeed Mr. Smith. **Charles Gale May** of Chicago, chief storekeeper, succeeds Mr. Jay as assistant works accountant.

W. F. Huntley was named superintendent of the blast furnace department at Aliquippa, Pa., works of Jones and Laughlin Steel Corp. Mr. Huntley succeeds the late **Elmer H. Riddle,** veteran blast furnace operator, who retired recently. Mr. Riddle died on April 6. **A. T. Sadler, Jr.,** succeeds Mr. Huntley as assistant superintendent of the blast furnace department. At Pittsburgh, Pa., works: **Si Feigenbaum** has been named works metallurgist. He succeeds **S. C. Faddis** who has been transferred to the Cleveland, Ohio, works division. At Cleveland, Ohio, works: **S. C. Faddis** has been named assistant works manager succeeding **J. M. McColloch** who has retired. **K. S. Loofboro,** acting assistant superintendent of blast furnaces at Aliquippa works, was named superintendent of blast furnaces, coke works, and dock at Cleveland works.

O. M. Wilt was made assistant superintendent of the tin and terne coating department of Wheeling Steel Corp., Steubenville, Ohio.

J. E. Hill, superintendent of the Fairfield, Ala., tin mill of Tennessee Coal & Iron division of U. S. Steel Corp., has been appointed to head a newly established

J. E. HILL

tin mill products division of the sales department as manager of sales. Succeeding Mr. Hill as tin mill superintendent will be **Roman J. Meyer,** superintendent of the Fairfield sheet mill. **D. A. Haarbauer,** formerly assistant superintendent of the Fairfield sheet mill, advances to superintendent, succeeding Mr. Meyer,

ROMAN J. MEYER

and **M. F. Glascock,** formerly assistant to the general superintendent of the Fairfield sheet and tin mills, is promoted to assistant superintendent of the Fairfield Sheet Mill.

Gerard E. Balsley was named director of industrial relations of Kaiser Steel Corp., Fontana, Calif. Formerly industrial relations director for Chase Aircraft, Mr. Balsley will administer the activities of the labor relations, personnel and plant protection departments.

Frank F. Argust has been appointed superintendent of industrial engineering of the Colorado Fuel and Iron Corp., Pueblo, Colo. Mr. Argust, in 1950, became senior industrial engineer, a position which he held only six months before being advanced to assistant superintendent.

Buell Whitehill, Jr., associate professor and head of the speech department at the University of Pittsburgh, has been named personnel director of Rust Engineering Co., Pittsburgh, Pa. Mr. Whitehill will succeed **O. M. Rutledge** who is resigning to raise beef cattle on his plantation near Charleston, S. C. Mr. Rutledge has been with the Rust firm for 16 years. Mr. Whitehill will be on leave of absence from his duties at the University with which he has been associated since 1937.

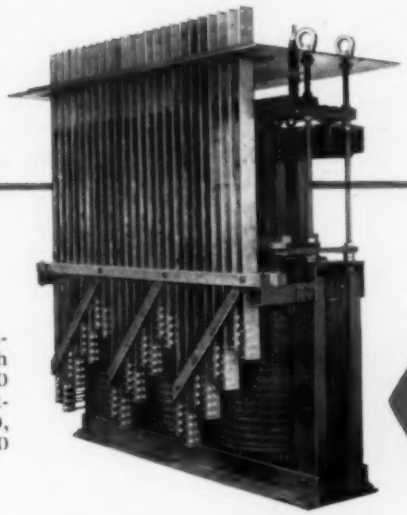
Francis B. Herlihy, formerly assistant chief metallurgist, has been appointed chief metallurgist of the American Brake Shoe Co., it was announced recently Mr. Herlihy, who joined the company in 1945, is located at the company's research laboratories in Mahwah, N. J.

Establishment this week of a new branch office in Baltimore, Md., by the Reliance Electric & Engineering Co., Cleveland, Ohio is announced by K. S. Lord, Philadelphia district manager of the company.

Mr. Lord said that this new Baltimore branch office, located at 13 West 25th Street, enables the company to broaden the availability of Reliance sales application

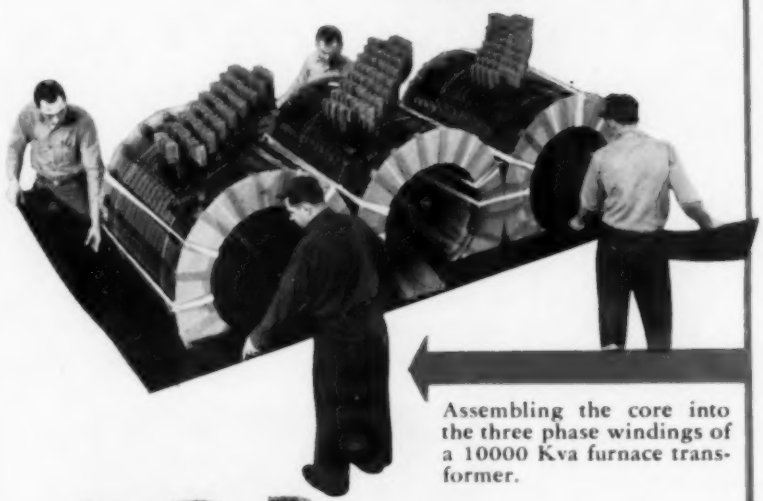
NOW *15 years of Proof*

behind the design of each PENNSYLVANIA FURNACE TRANSFORMER



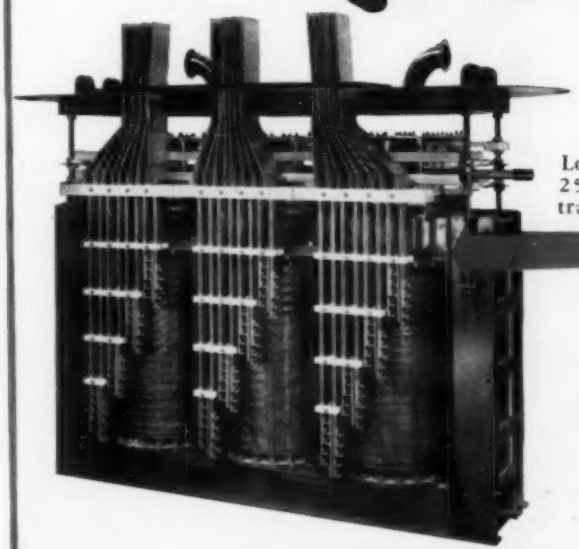
2500 Kva Transformer; High voltage — 3300 volts; Low voltage — 140, 130, 120, 110 and 100 volts.

Fifteen Years Ago... Pennsylvania Transformer Company introduced a new type of helical winding in the low voltage coils of a 2500 Kva furnace transformer. Since then, Pennsylvania has manufactured over 1¼ million Kva of furnace transformers using the same fundamental principles of design employed in this 2500 Kva unit.



Assembling the core into the three phase windings of a 10000 Kva furnace transformer.

In all the intervening years, there has *never* been a low voltage winding breakdown on any of these furnace transformers. Because this design is basically and fundamentally correct, Pennsylvania can build furnace transformers for any size electric furnace now being manufactured or being contemplated for future construction.



Low voltage side. 25000 Kva furnace transformer.

Pennsylvania TRANSFORMERS

Pennsylvania
TRANSFORMER COMPANY
CANONSBURG, PA.
Greater Pittsburgh District

and technical engineering service to users of a-c and d-c motors, adjustable-speed drives, gearmotors and related electrical equipment in the tristate area embracing south central Pennsylvania, Maryland and Virginia.

The office is staffed by A. C. Schettler and W. C. Mitchell, sales engineers. Mr. Mitchell will cover the metropolitan Baltimore area. Mr. Schettler is moving from New York to Baltimore and will continue to serve users of Reliance products in the York-Waynesboro-Richmond-Norfolk area.

Thomas D. Cartledge was elected vice president of Union Carbide and Carbon Corp., New York, N. Y. Mr. Cartledge has been president of Linde Air Products

THOMAS D. CARTLEDGE

Co., a division of Union Carbide and Carbon Corp. He is also a director and president of Dominion Oxygen Co., Ltd., Canada.

Martin B. Westerman was named assistant director of labor relations of Kaiser Steel Corp., Fontana, Calif. Mr. Westerman has been with Kaiser Steel since 1948 as a labor relations representative.

Theodor Wutscher was named chief designer of the rolling mill division of Hydropress, Inc., New York, N. Y.

Morton E. Weichsel has been appointed manager of industrial engineering for Colorado Fuel and Iron Corp., Pueblo, Colo. Mr. Weichsel has served as superintendent of industrial engineering at Minnequa works since February, 1947. He will be located at the Buffalo, N. Y., office of the company.

William D. Canan, chief mechanical engineer of Rust Engineering Co., Pittsburgh, Pa., has retired after 28 years of service. Mr. Canan has been active as an engineer for over 43 years.

Walter W. Wendelken has been appointed director of works engineering for the headquarters manufacturing division of the Westinghouse Electric Corp., East Pittsburgh, Pa. Mr. Wendelken has had a long career in works engineering in Westinghouse beginning first in 1917 at the East Pittsburgh works in the power plant department. He was appointed chief electrical engineer of the headquarters works engineering department in 1949, from which position he goes to his new assignment.

J. M. Hendrickson was appointed vice president of Pannier Corp., Pittsburgh, Pa. In his new position, Mr. Hendrickson will be in charge of research and development. He was formerly director of mechanical research at the Eljer Co., Ford City, Pa., for thirteen years, and had complete charge of product design and development.

H. E. Jensen, chief engineer of C & D Batteries, Inc., of Conshohocken, Pa., has been appointed vice president in charge of engineering. Mr. Jensen joined the engineering staff of C & D Batteries as a research and development engineer in 1950. In October, 1951, he became chief engineer.

John L. Goheen has been named district manager for commercial research for American Brake Shoe Co. on the West Coast. Mr. Goheen joined the Brake Shoe Co. as a research metallurgist in 1943. He served in the metallurgical research laboratories until 1950 when he transferred to market research and development work. Mr. Goheen will supervise market studies and the development of new applications for the company's standard products in the West Coast area. He is located in the San Francisco, Calif., office of the company at 1010 Russ Building.

Bruce Herbert was named direct factory representative in Minnesota and Wisconsin for Rollway Bearing Co., Inc., Syracuse, N. Y. Formerly in the industrial distributor sales department of Rollway at Syracuse, Mr. Herbert has opened an office in the Administration Building, 647 W. Virginia St., Milwaukee 4, Wisc.

Andrew Gensey was appointed director of the labor relations department of Kaiser Steel Corp., Fontana, Calif. Formerly assistant director of labor relations,

ANDREW GENSEY

Mr. Gensey succeeds to the position held by **Joseph B. Petty,** recently deceased, with whom Mr. Gensey had worked closely for many years.

...with TYCOL lubricants on hand!

Heavy-duty cutting operations? Here's what happens when you switch to Tycol Afton oils! A well-known Engineering Company (you'd recognize the name instantly) recently tested cutting oils used to shape 14″ gears on a Gleason Bevel Gear Generator. Their findings: after the first rough cut around, with competitive oils, they had to grind a full ⅛″ off the cutter. With Tycol Afton 8, they hobbed *two* gears and took off only .013″. Afton oils are non-corrosive . . . and so stable they're widely recommended as hydraulic oils! They serve a triple function as coolants, lubricants, and hydraulic media on the same machine . . . the heavier the cut – the better they perform. It will pay you to find out why – by contacting your local Tide Water office!

Over 300 Tycol industrial lubricants are at your disposal . . . engineered to fit the job!

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REFINERS AND MARKETERS OF VEEDOL . . . THE WORLD'S MOST FAMOUS MOTOR OIL

Dean B. Valentine has been named assistant superintendent of industrial engineering of Colorado Fuel and Iron Corp., Pueblo, Colo. Mr. Valentine had been serving as senior industrial engineer since 1947.

John W. Anne has been elected a vice president of Elliott Co., Jeannette, Pa. He has been with the

JOHN W. ANNE

company since 1925 and since 1948 has been sales manager of the Jeannette division.

S. W. Crisman has been appointed assistant district manager of Elliott Co.'s Pittsburgh, Pa., office. Mr. Crisman went with the Elliott Co. in 1935, and

S. W. CRISMAN

has been serving as a field engineer in the Pittsburgh district office.

Frank J. Donahue was named supervisor of training placement in the Allis-Chalmers Manufacturing Co.'s graduate training section.

Humbert C. Cozza, Jr., who joined Lewis Machinery division of Blaw-Knox Co. last July, has been appointed manager of industrial engineering. His previous experience includes three years with the local Edwin L. Weigand Co., and five years with La Consolidada, S. A., and other manufacturing firms in Mexico. **John A. Deer** has been appointed manager of production planning and control. Starting with the division in 1941, he was promoted to assistant production manager in 1946 and became production manager in 1947.

William J. Greene was named assistant director of metallurgical research for Air Reduction Co., Inc., research laboratories at Murray Hill, N. J. Mr. Greene joined Air Reduction in 1946 as a research and development engineer and has served successively as assistant to the manager and assistant manager of the metallurgical process division.

George L. Anderson was named assistant to the general purchasing agent of American Brake Shoe Co., New York, N. Y. Mr. Anderson joined the company in 1923 and was formerly a buyer in the New York office.

Thomas E. Breyley was named midwest manager of engineering and equipment sales for York Engineering and Construction Co., and York-Gillespie Manu-

THOMAS E. BREYLEY

facturing Co. He will develop the York sales organization for a territory comprising Ohio, Indiana, Illinois, Michigan, Iowa, Minnesota, Wisconsin, Missouri, North Dakota, South Dakota, Nebraska, Kansas and Kentucky.

Thomas D. Johnson was appointed to the Atlanta, Ga., sales application engineering staff of Reliance Electric & Engineering Co. Mr. Johnson will make his headquarters at the company's Atlanta office, 427 Candler Building. He joined the Reliance organization last October. His other business experience includes three and a half years as a development engineer with another electrical manufacturing concern, and a year with the Brush Development Co.

Stewart E. Doughty, quality control supervisor, has been elected to the board of directors of C & D batteries, Inc., Conshohocken, Penna.

John W. Moffat has been appointed district sales manager for the Refractories division of Babcock & Wilcox Co. at Pittsburgh, Pa. He succeeds **Mark J. Terman** who recently became sales manager of the

ANOTHER* EXAMPLE OF ELLIOTT Excellence IN MOTORS

* SILVER BRAZING

. . . for permanence in many joints and connections

■ By many tests silver alloy brazing has been proved to make joints that are stronger than the metal parts being joined. It is used in Elliott motors and generators in all joints where permanence and the maximum conductivity of an enduring bond are essential. Below is shown the process of silver brazing the compensating winding joints in a large direct-current motor. The compensating winding—first developed by Elliott Ridgway Works in 1895—consists of copper bars insulated with mica, inserted in slots in the pole faces.

SHOWN AT LEFT is the completed Elliott 800 hp, 175/350 rpm, 600 volt D-C mill type motor with force ventilation covers and tachometer generator. This motor drives a Bliss reversing strip mill.

For full details on this and other Elliott motors, contact your local Elliott representative or write Elliott Company, Ridgway, Pa.

ELLIOTT Company

RIDGWAY DIVISION

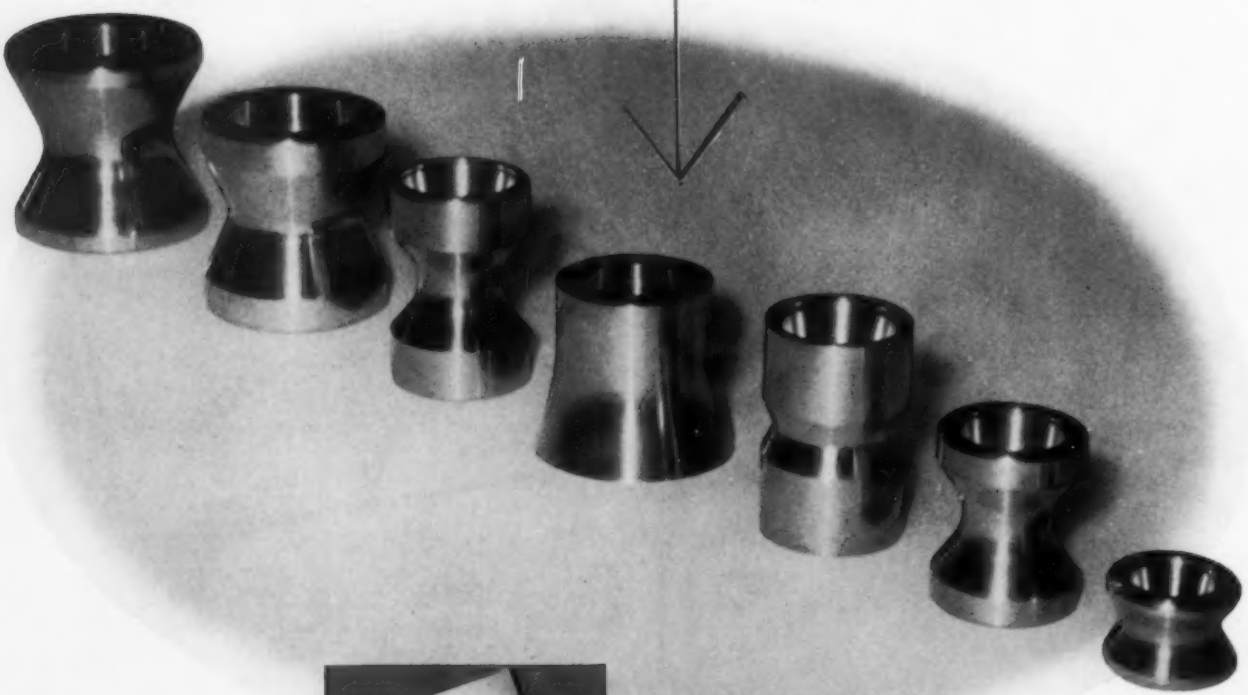
ELLIOTT ELECTRICAL EQUIPMENT INCLUDES CROCKER-WHEELER INDUSTRIAL MOTORS

R2-14

These are the STOODY CASTINGS that cut steel-making costs!

As time goes on, more and more of the principal steel plants are replacing the conventional alloy steel guide rolls with Stoody alloy castings costing 3 to 5 times as much. Such replacements invariably follow exhaustive tests by the mills themselves.

In the final analysis, actual part costs are determined solely by the record of production. Stoody castings are chosen on this basis alone—longer life, a fine finish that leaves the steel unmarked and—most important—less down-time for replacement.



We should like to send operating personnel a copy of the newly revised booklet, "Stoody Castings." Your request on your company letterhead will be answered promptly.

STOODY COMPANY

11942 EAST SLAUSON AVENUE, WHITTIER, CALIFORNIA

Refractories division with headquarters at New York. **Robert H. Forsyth** has also been transferred to the Pittsburgh district office from the New York district sales office.

John C. Tarvin was named field sales manager (industrial products) for S. C. Johnson and Son, Inc., Racine, Wisc. **Raymond F. Farley** has been appointed to the post of western regional supervisor (industrial products). In his new post Mr. Tarvin will supervise throughout the United States the marketing and distributing of Johnson's industrial products. Mr. Farley who replaces Mr. Tarvin as western regional supervisor will supervise the selling of the company's industrial products throughout the west-central states.

Ewald Carlson, general foreman of Kaiser Steel Corp.'s electric weld pipe mill was appointed superintendent of the mill at Fontana, Calif.

Walter F. Schmid was appointed to the position of assistant general sales manager of De Laval Separator

WALTER F. SCHMID

Co. Mr. Schmid was formerly manager of the company's refrigeration division.

Carl W. Ludwig, general foreman of Kaiser Steel Corp.'s soaking pits and blooming mill, has been promoted to the position of assistant superintendent of that operation at Fontana, Calif.

Sam E. Gewin has been appointed district manager of the St. Louis, Mo., office of Bristol Co., Waterbury, Conn. For the last five years Mr. Gewin has been resident sales engineer in the Buffalo, N. Y., area. Mr. Gewin's new headquarters will be in the Cotton Belt Building, St. Louis, Mo.

James R. McCutcheon, Jr. was named as manager of piping supplies department of Pittsburgh Gage and Supply Co. Mr. McCutcheon was formerly connected with National Tube Co., American Car & Foundry Co., valve division, and Homestead Valve Manufacturing Co.

Curtis Meyer was made sales manager of the electric hoist division of Harnischfeger Corp. Mr. Meyer was recently a director and vice president in charge of sales for Milwaukee Electric Tool Corp.

William R. Jenkins was named sales representative in the Youngstown, Ohio, district for United Engineering and Foundry Co. Mr. Jenkins will assume the duties of the late **Walter B. Jenkins.** He started with United

WILLIAM R. JENKINS

Engineering and Foundry Co. in 1934 and has had 19 years of service and experience in production control work. He was formerly assistant production manager of the Youngstown plant.

Lee Calvin Hopper has been appointed advertising manager of Elwell-Parker Electric Co., Cleveland, Ohio.

LEE CALVIN HOPPER

In addition, Mr. Hopper will direct export sales activities. He succeeds **C. B. Cook** who retired recently.

Richard Y. Moss was elected vice president and manager of the Canton, Ohio, division of E. W. Bliss

Co., Canton, Ohio. **Robert Shannon** becomes vice president and manager of the Hastings, Mich., division and **Albert E. Whyman** was made vice president in charge of European operations.

W. R. Dunn has been appointed divisional controller of the western division of Colorado Fuel and Iron Corp. Mr. Dunn's headquarters will be at the Pueblo, Colo. offices of CF&I, where all central records of the corporation will continue to be maintained. Mr. Dunn will supervise controllership of CF&I and subsidiaries in the western half of the United States, as well as maintaining the central records.

J. Allen Greenland has been named sales manager of the San Francisco, Calif., district office of the De-Laval Turbine Pacific Co. and **Donald T. Bixby** as sales manager of the Seattle, Wash., district office. The De-Laval Turbine Pacific Co. is a wholly owned De-Laval Steam Turbine Co. subsidiary with main offices and plant in San Francisco and district offices in Los Angeles and Seattle.

David K. Tomer has been appointed to the headquarters staff of Blaw-Knox Co. as manager of the control section. Mr. Tomer began his business career in 1930 with the Koppers Co. as a field engineer. He advanced to contract engineer and in 1947 became assistant manager in Koppers' Chile management division, in which post, he assisted in directing the engineering, purchasing and construction of a large integrated steel plant in Chile. During the past year he has been supervisor of construction for the Atlantic Refining Co. at Philadelphia, Penna.

D. R. Strouse was appointed production manager of Tube Reducing Corp., Wallington, N. J. Mr. Strouse joined Tube Reducing Corp. in January, 1953 and served in an engineering capacity before this appointment.

C. M. Ahearn was named divisional controller of the eastern division of Colorado Fuel and Iron Corp. Mr. Ahearn will assume supervision of the controllership functions of all eastern division subsidiaries of CF&I, including the recently acquired John A. Roebling's Sons Corp. His headquarters will be in the executive offices of CF&I in New York, N. Y.

John D. Williams has been elected vice president and general manager of Rollway Bearing Co., Inc., Syracuse, N. Y., succeeding **William B. Smithers,** who resigned recently. Mr. Williams also holds the same positions in Lipe-Rollway Corp.

Alfred E. Carpluk has joined the sales engineering staff of Trumbull Electric department of General Electric Co. He will be located in the Boston, Mass., office. Before accepting his new position Mr. Carpluk was a sales engineer with the small and medium motor department of General Electric at Lynn, Mass.

Erhardt C. Koerper was named works manager of Ampco Metal, Inc., Milwaukee, Wisc. Mr. Koerper had been assistant executive engineer engaged in special products engineering and the coordination between laboratories and production at the A. O. Smith Corp.

Jack H. Eisaman, was appointed sales and service representative for International Graphite & Electrode division, Speer Carbon Co., for the mid-west region. Mr. Eisaman was formerly superintendent of No. 4 open hearth, South Chicago, Ill., works, U. S. Steel Corp. Prior to his open hearth experience, he had been superintendent of No. 2 electric shop at South works.

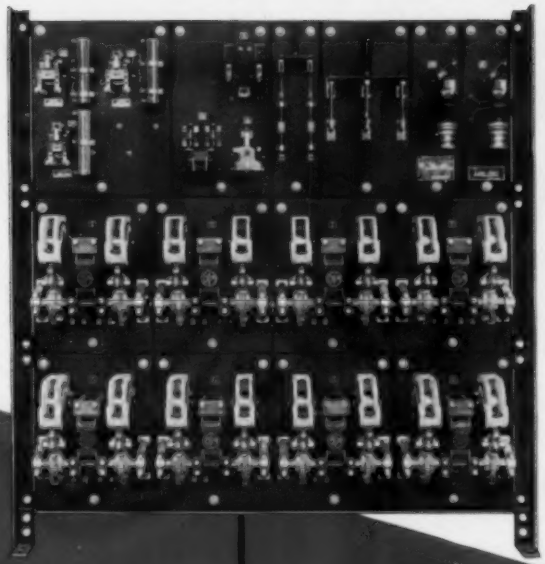
William G. Blessing was appointed manager of purchases of the Lewis Machinery division of Blaw-Knox Co. At the same time, **C. E. Lewis** was named divisional purchasing agent of the machinery department, and **R. L. Cramer** was appointed divisional purchasing agent of the ordnance department. Mr. Blessing has been with the division as ordnance purchasing agent since early in 1951.

Obituaries

James W. McLaughlin, 62, vice president, Union Carbide and Carbon Corp., died May 15. Mr. McLaughlin was chairman, Bakelite Co. and Bakelite Co. (Canada), Ltd.; vice president, Carbide and Carbon Chemicals Co.; and vice president and director, Carbide and Carbon Chemicals Co., Ltd., all associated with Union Carbide.

Emmett A. Williams, 62, vice president of the National Bearing division of American Brake Shoe Co., died on April 14. Mr. Williams has been with National Bearing since 1913. He was made manager of its Meadville, Pa. plant in 1928, when it became a subsidiary of American Brake Shoe Co.

Myron J. Berman, 57, official of the Factory Stores organization in Pittsburgh, Pa., died May 13. Mr. Berman was born and reared in Cleveland, Ohio, and was transferred to Pittsburgh 25 years ago by his firm. He had been associated with Factory Stores for about 37 years.



One of several Frequency-Relay Controlled Cranes helps speed steel-handling in warehouse.

EC&M FREQUENCY RELAYS

Give an EXTRA BOOST To A-c Cranes

FREQUENCY RELAYS
ACCELERATING
PLUGGING
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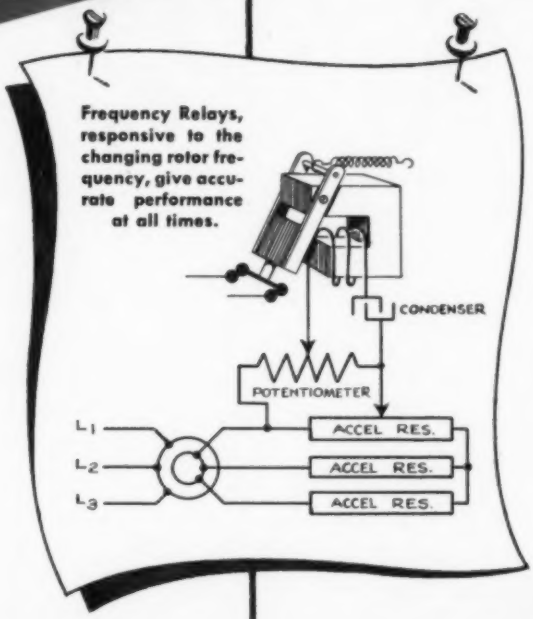

Frequency Relays, responsive to the changing rotor frequency, give accurate performance at all times.

MOTOR OPERATION SAFEGUARDED OVER ENTIRE SPEED RANGE

You can rely on EC&M FREQUENCY RELAYS to control a-c wound-rotor motors with precision throughout all operating speeds. Because they operate from a resonant circuit, these relays are positive in response and accurate in operation.

Used on EC&M Magnetic Hoist Controllers which are designed with *weak* torques for *good* inching, EC&M FREQUENCY RELAYS give you these inching qualities with complete safety. If the loads are heavy and overhauling, the motor does not overshoot regenerative lowering speeds. And on reversing controllers, these Relays control the plugging contactor at exact standstill and give smooth acceleration when starting up from rest or from a coasting start.

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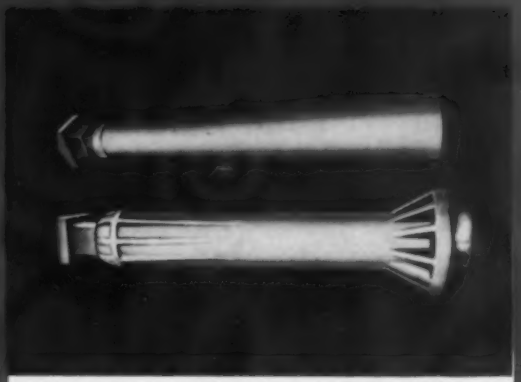

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RELIANCE V★S DRIVE with

the new *Totally-Enclosed Dual-Cooled* motor

PATENT APPLIED FOR

For continuous operation over extremely wide speed ranges . . . or wherever unusually severe operating conditions must be met . . . the new Reliance Totally-Enclosed Dual-Cooled Motor extends the application range of the V★S Drive. Wherever high ambient temperatures, intermittent operation, prolonged low-speed operation, or severe duty cycles pose difficult cooling problems, Reliance V★S Drive with Dual-Cooled Motors have proved to be the best answer. The new Dual-Cooled Motor is available either totally-enclosed or explosion-proof, conforming to Bureau of Mines and Underwriters' specifications, in ratings from 15 through 150 hp. D-1464

GET THESE FACTS NOW!

Your request for Bulletin C-2201 will bring you this new booklet featuring large cutaway drawing with 3-color transparent overlay showing operation of Reliance Dual-Cooled Motor, together with fact-filled bulletin showing production increases and operating economies obtainable with Reliance V★S Drive.

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JUNE, 1953

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(1) Unit Heaters

A new bulletin, just released, illustrates a new line of suspended space heaters for use with any type of gas fuel. This new gas fired heater has been added to the line of Dravo "Counterflo" heaters which have received wide industrial acceptance. The folder gives complete specification data with dimensions and capacities of both propeller fan and blower type units. Available output capacities of these gas fired suspended heaters range from 70,000 to 178,000 Btu per hour. Full explanations show how they can be used in commercial and industrial applications for heating, ventilating and process drying, either with or without ductwork. The heaters have cast-iron burners and heat exchangers and are approved by the American Gas Association and are listed by the Underwriters' Laboratories, Inc. (543). Dravo Corp.

(2) Switch Materials

Savings in time and money through single-source buying of track materials and supplies are pointed up in a new catalog, titled "Switch Materials," just issued. One of the features of the new catalog is general information to aid industry in the ordering and installation of frogs, switches and stands. Included in the 44-page catalog are illustrations, descriptions and specifications of crossings, frogs, gage plates, guards, rails, guard rail clamps, heel blocks, rail braces, slide plates, combination slide plates and braces, spring connecting rods, spring head rods, switch lugs, switch rods and bars, transit clips and rods, twin tie plates, switch points, switches and stands, switch materials for light rail installations, turnouts and timber requirements. (575A). L. B. Foster Co.

(3) Sequence Valve

A bulletin is available that gives details on a sequence valve. This improved "Airmatic" valve permits single control of multi-operations. Its use increases production with less fatigue by enabling the operation of two or more cylinders, in their correct sequence, without manual handling. A high degree of sensitivity allows positive operation at pressures from 20 to 200 psi air, oil or water. The valves are available in six standard pipe sizes from 1/4 in. to 1 1/4 in. (4812). Airmatic Valve, Inc.

(4) Electric Motor

Illustrated on the front cover of a new descriptive bulletin is a Wagner annular resilient mounted 3 hp motor which is one of many standard Wagner motors. These motors are provided with resilient base mountings in order to reduce the transmission of objectionable noises and vibration to the motor support. Wagner furnishes resilient mounted standard motors with bases constructed to support annular resilient rings mounted on the motor endplates for use on single phase and three phase power, and in fractional and integral horsepower motor ratings built in NEMA frame sizes 225 and smaller. (MU-94, No. 24). Wagner Electric Corp.

(5) Electrical Wiring Catalog

Completely illustrated and designed for quick and easy reference, a new catalog on electrical wiring has just been issued by the company. Containing pictures of the electrical wiring devices and "Turn-Tyte" interlocking devices manufactured by Rodale and distributed nationally, the catalog also contains many descriptive explanatory diagrams showing the details of manufacture. Rodale Manufacturing Co., Inc.

(6) Industrial Castings

Meehanite castings for industry are described in a new bulletin just published. Five engineering grades of Meehanite and several other heat-resistant and corrosion-resistant grades are produced by this company. The booklet describes characteristics of the material, lists properties, and carries engineering information on hardenability, section strength, and comparative properties of other cast metals. Typical applications are pictured and a table of standard bar stock sizes is included. American Brake Shoe Co.

(7) Electrical Controls

The publication of a new catalog has been announced featuring the various types of electric controls. Motor controls, switchgear, generator controls, marine propulsion systems and industrial process controls which this company custom-engineers for specialized applications are described and illustrated. The company's complete engineering, design and fabrication facilities are outlined and pictured, including the firm's facilities for quantity production of all types of electric controls. Lake Shore Electric, Inc.

(8) Industrial Ventilation

A new bulletin entitled, "Balanced Industrial Ventilation," has just been issued by the National Association of Fan Manufacturers, Inc. The scope of the bulletin is limited to the problems resulting from the relationship of exhaust and make up air systems, and the bearing it has on the heating load. Engineers, production men and the general public will find the bulletin helpful in understanding the problem arising from an exhaust system or systems and the means necessary to solve the problem.

(9) Half-Second Recorder

For the accurate recording of rapidly-changing variables, the pen of the new "ElectroniK" recorder will cross the full 11-in. width of the chart in 1/2 second. It will measure the output of any primary device which is accompanied by or can be made to produce an emf of 3 millivolts or more d-c, with an accuracy of ± 0.25 per cent. (Instrumentation Data Sheet 10.0-13). Minneapolis-

Honeywell Regulator Co., Industrial Division.

(10) Blast Cleaning

A bulletin is announced that describes the blast cleaning hose machines produced for hand-operated cleaning jobs. This new 28-page bulletin points out that, in spite of spectacular advances in automatic equipment and airless blast cleaning, there are many jobs which can only be accomplished by the use of hand-operated nozzle blast cleaning equipment. The two fundamental methods of applying the abrasive, direct pressure and suction, are described as well as the applications of both wet and soft abrasives. Tables are printed which show the relationship between orifice area and circumference in nozzle sizes and air flow with required hp to develop air jets of varying diameters. Selection of the proper type of Pangborn blast cleaning hose machine is thoroughly discussed in the book. A useful table graphically shows how to match the nozzle size to the size of the abrasive being used. Various blast cleaning accessories are pictured and described. Specifications are given for the various types of abrasives available along with recommendations for their use. (100A). Pangborn Corp.

(11) Heat Treatment Principles

Publication of a new booklet entitled, "Principles of Heat Treatment," is announced. Annealing, hardening, martempering, austempering and surface hardening are explained in detail through the use of numerous charts and photographs, as they pertain to Meehanite metal. Equilibrium diagrams, dilatation curves, "S" curves and Jominy curves, with their explanations, are included. The 43-page booklet also contains illustrations of the use of heat treated Meehanite castings in a variety of engineering applications. Meehanite Metal Corp.

(12) New Trade Literature Available

Two new bulletins were recently issued that describe in detail the specifications and applications of Federal Electric's line of manual and magnetic motor starters. Bulletin 404, describing "Noark" manual motor controls, lists special design features such as double-break silver contacts, ready servicing accessibility, and complete mounting flexibility. Available in 2, 3, or 4 poles for single phase, 3 phase, and 2 phase 4 wire systems, Federal's manual starters come in two sizes for a-c operations; Size O, rated up to 2 hp and Size 1, rated up to 7½ hp, both at 600 volts a-c. Other models are obtainable for d-c operations in ratings up to 1 hp (Size OS) and 2 hp (Size 1S), both at 230 volts d-c. In the second bulletin of this series, Bulletin 504, Federal Electric describes the design features and uses of its line of magnetic motor starters, available in three basic forms—remote control, local control, and selector switch control—in five types of enclosures. Made in standard NEMA sizes, 0, 1, 1½, 2, 3, 4, 5, and 6, they are produced in standard voltages of 110, 220, 440, and 550 volts, with ratings up to 400 hp a-c (404 and 504). Federal Electric Products Co.

(13) Electromagnets

A new illustrated bulletin on a line of electromagnets and magnet controllers is announced. The bulletin is illustrated with cutaway sections, photos, and application shots of Ohio lifting, separation, and road-sweeping magnets. It also gives magnet weights and lifting capacities for all standard bolted, welded and basket type Ohio Magnets. (112). Ohio Electric Mfg. Co.

(14) Plant and Machinery Paint

Just released is a new color-chip folder illustrating and describing the new Rust-Oleum restful color group for plant interiors and machinery. The new restful color group is specially prepared to assure pleasing colors and harmony in contrasts. Machinery finishes include 842 Grandeur Gray, 840 Harmony Green, 844 Crescent Ivory, and 848 Pleasant Green. Restful color group finishes for walls, ceilings, etc. include 831 Restful Green, 835 Cosmic Gray, 837 Sun-Glo, and 839 Vertex Green. Each of these eye-soothing hues is designed to harmonize perfectly with the existing interior decorations and blend into an overall color scheme that will provide ideal work surroundings in plants, offices, schools, institutions, commercial buildings, etc. (125). Rust-Oleum Corp.

(15) Multi-Point Recorder

A new technical information sheet has been issued that describes the various combinations of control and alarm available with the multi-record "Dynalog" recorder. By adding simple electrical mechanisms, the electronic recorder can be made to actuate alarm systems and control process variables, in addition to continuously recording up to six measurements of temperature, flow or conductivity on a single chart. Optional control and alarm functions include a common alarm, actuated by any of the measured variables; a selective alarm with individual alarm setting for each point; on-off control which fully opens and closes a control valve and automatically "resets" the actuated relay when the process error has been corrected; and three-position control which operates at high-low-normal values. The factual sheet also contains valuable reference data on setting mechanisms, control circuit variations, relay ratings and specifications for Rotax circuits. Diagrams clarify each of the four control or alarm actions, showing typical circuits and their industrial applications. (TI-33-A-15A). Foxboro Co.

(16) General Service Pump

A new pump for general industrial service is described in a bulletin that is available. This pump operates in a speed range of 200 to 400 rpm and delivers from 12.5 gpm at 100 rpm up to 50 gpm at 400 rpm with a maximum pressure of 2050 psi using a a 1¾-in. diam plunger. The maximum size plunger, 2¾-in. diam, delivers 30.8 gpm at 100 rpm and 123.5 gpm at 400 rpm with a maximum pressure of 825 psi. This unit is designated the Ajax TP-4000 series pump. Designed for continuous, 24-hour per day service, the new pump is of vertical, triplex construction which provides maximum hydraulic horsepower in minimum floor space. The entire power end of the pump is enclosed, affording weather protection and safety of operation. The fluid end is sectionalized, and separate from the power end; straight-line flow minimizes turbulence. Tapered, double-row, factory-adjusted roller main bearings are used for the crankshaft. (531). Ajax Iron Works.

(17) Inter-Communication System

In a recently released bulletin, a new concept in inter-communication systems, known as the "Femco Pagephone," is described. The systems provide clear, natural and distinct speech over standard tele-

phone-type handsets, plus a unique "all hear" paging feature which utilizes a built-in loudspeaker system. Because these systems use one central amplifier, one common cable and require no operator, they are an inexpensive means of replacing the complexity of switchboards. Models for standard duty, heavy duty and mill duty are available. The new bulletin is included as part of a "Femco Data Kit," a collection of literature which describes communication products. (28 and the complete "Femco Data Kit"). Farmers Engineering and Manufacturing Co.

(18) Motor-Generators

A bulletin is available that describes motor-generators from 3/4 to 1500 kw. In six pages, the bulletin illustrates 23 designs of a-c to d-c, a-c to a-c, d-c to d-c and d-c to a-c motor-generators. Electrical specifications and application of each design are given. Electric Products Co.

(19) High Speed Heating Furnaces

The current trend toward increased industrial application of high speed heating serves to highlight a new bulletin just released. This bulletin points up the many advantages of high thermal head heating, with gas or oil, for press forging, upsetting, extruding, stress relieving of ferrous and nonferrous metals. Basic furnace designs and burner arrangements are described in conjunction with the demands of overall or selective heating for semi-automatic or fully automatic production. (SC-162). Surface Combustion Corp.

(20) Meters and Controls

A comprehensive catalog is available offering information on a complete line of meters, control equipment and engineering services. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, illustrations, and detailed literature references are included. (18). Bailey Meter Co.

(21) Descaling Steel Sheets

Descaling hot-rolled steel sheets by airless blasting and eliminating acid disposal problems are the topics discussed in a new bulletin just published. Giving an actual case history with performance data, and illustrated by photographs of the equipment employed, plus a flow diagram of a sheet descaling line, this bulletin shows how important savings were made available to one company by airless blasting, because it was able to conveniently employ hot-rolled steel in place of cold-rolled. (914.) American Wheelabrator and Equipment Corp.

(22) Adjustable-Speed Drive

An informative, interesting booklet describing and illustrating a newly improved electronic adjustable-speed drive of from 3/4 to 3 hp designed for powering a wide range of small industrial equipment economically has just been released. Holding special interest for designers of small machinery, process engineers, production executives and purchasing directors among others, this bulletin provides a comprehensive yet concise presentation of the Reliance V*S, Jr. Ten outstanding operating functions and performance features provided by this "junior" edition of the packaged, all-electric Reliance "V*S Drive" as applied to various production jobs and processing operations are reviewed. Highlighted pictorially are 11 typical applications. In addition, the booklet describes the components and optional accessories of the new drive, gives its physical dimensions and five different horsepower ratings in which the unit is available, graphically charts horsepower and torque characteristics, and enumerates six specific ways in which industry utilizes this improved drive to increase output, reduce costs and improve product quality. (D2102). Reliance Electric & Engineering Co.

(23) Circuit Breakers

The application of AB-1 circuit breakers to reduce downtime and maintenance is discussed in a booklet available to you. Actual cases—with savings given—show how the replacement of fused devices by AB-1 circuit breakers result in improved continuity of operation. Complete design and operating details are provided, and typical applications for each of the seven different types of enclosures are given. A basic selection-data chart for general purpose NEMA 1A sheet steel enclosures is provided as well as a downtime cost comparison sheet for circuit protection. (B-5456). Westinghouse Electric Corp.

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PUBLICATIONS CURRENTLY OFFERED by Iron and Steel Engineer Advertisers

ITEM	COMPANY	BULLETIN	DESCRIPTION
50	AJAX FLEXIBLE COUPLING CO., INC.		Catalog available on Ajax couplings.
51	AMERICAN AIR FILTER CO., INC.	BULLETIN 250	AAF Electro-Matic.
52	AMERICAN MANGANESE STEEL DIVISION, AMERICAN BRAKE SHOE CO.		Illustrated catalog available on Amscoating.
53	AMERICAN CHEMICAL PAINT CO.		Descriptive folders and Government specifications chart available on ACP phosphate coating chemicals.
54	BLISS CO., E. W.	BULLETIN 40	52-page brochure on Bliss mills.
55	C & D BATTERIES, INC.	BULLETIN IT-517 AND IT-518	C & D Slyver-Clad industrial truck batteries.
56	CLEVELAND WORM & GEAR CO.	CATALOG 400	Describes the entire Cleveland line of worm gear drives.
57	COLUMBIA ELECTRIC MFG. CO.		Descriptive bulletins available on Columbia motor generators.
58	CUNNINGHAM CO., M. E.		Complete catalog available on safety marking tools.
59	CURRY & CO., INC., ALBERT		Curry list of available steel plant equipment.
60	DE LAVAL SEPARATOR CO.	BULLETIN 500	DeLaval lubrication systems.
61	DIAMOND POWER SPECIALTY CORP.	BULLETIN 1025E	Diamond "Utiliscope."
62	DRAVO CORP.	BULLETIN QX 1301-5	Tells about Dravo crane cab coolers.
63	DREVER CO.	BULLETIN B-52	Drever ammonia dissociator.
64	ELECTRIC CONTROLLER & MFG. CO.	REPRINT BULLETIN T9-117	Describes the EC&M Valimitor.
65	ELECTRIC MACHINERY MFG. CO.	BULLETIN 211 AND FOTO-FACTS 21	Show step-by-step illustrations of SA-FUSE operation.
66	ELECTRIC SERVICE MFG. CO.		Illustrated folder available on Keystone insulators.
67	ENTERPRISE CO.	BULLETIN 301	Describes Enterprise heavy-duty forge lathes.
68	FLOWER MANUFACTURING CO., D. B.	CATALOG 41	Tells about Flower brush holders.
69	FOOTE BROS. GEAR AND MACHINE CORP.	BULLETIN HGB	Contains information on hydrade worm gear drives.
70	GENERAL ELECTRIC CO.	BULLETIN GEA-5409A	G-E limitamp control.
71	GULF OIL CORP.		"Gulf E.P. Lubricants for Rolling Mill Gears."
72	HARBISON-WALKER REFRACTORIES CO.	BULLETIN EB-11	Harbison-Walker plastic fire brick and castable refractories.
73	HARNISCHFEGER CORP.	BULLETIN C-42	P&H mill type cranes.
74	JOHNS-MANVILLE	BROCHURE IN-115A	J-M insulating materials.
75	KOPPERS CO., INC.		Catalog available which gives detailed descriptions, engineering drawings, capacity tables and photographs.
76	LEEDS AND NORTHRUP CO.	PUBLICATION ND46(1)	Contains information on the L&N Speedomax.
77	LINTERN CORP.	BULLETIN AC-533	Tells about Lintern aire-rectifiers.
78	LOVEJOY FLEXIBLE COUPLING CO.		Catalog and quick-finding selector charts available on Lovejoy flexible couplings.
79	LUBRIPLATE DIVISION, FISKE BROTHERS REFINING CO.		56-page Lubriplate data book available.
80	MARTINDALE ELECTRIC CO.	CATALOG NO. 29	Describes Martindale electrical, industrial and maintenance equipment.
81	MEDART CO.		Illustrated brochure on the Medart centerless turner.
82	MINNEAPOLIS-HONEYWELL REGULATOR CO.	CATALOG 1530	ElectroniK Controllers.
83	NATIONAL ALLOY DIVISION, BLAW-KNOX CO.	BULLETIN 2041	National Alloy products and procedurrs.
84	PITTSBURGH LECTROMELT FURNACE CORP.	CATALOG 8	Describes Lectromelt furnaces.
85	POOLE FOUNDRY AND MACHINE CO.		Catalog on flexible couplings.
86	PYLE-NATIONAL CO.	CATALOG 2100	Pyle-National heavy duty floodlights.
87	RELIANCE ELECTRIC AND ENGINEERING CO.	BULLETIN C-2201	Contains information on Reliance dual-cooled motors.
88	STEARNS MAGNETIC, INC.		Literature available on Stearns lifting magnet.
89	STOODY CO.		Bulletin describes Stoody castings.
90	TAYLOR SONS CO., CHAS.	BULLETINS 315 AND 313	Tasil ramming mixes and Tasil hydrocast.
91	UNITED STATES GRAPHITE CO.		40-page catalog on standard USG brushes.
92	WAGNER ELECTRIC CORP.	BULLETIN MU-185	Wagner protected type motors.
93	WESTINGHOUSE ELECTRIC CORP.	BULLETIN B-4695	Westinghouse equipment for arc furnaces.
94	WESTINGHOUSE ELECTRIC CORP.	BULLETIN B-5417	Load-O-Matic a-c crane hoist control.
95	WILSON ENGINEERING CO., INC., LEE		Fully illustrated brochure on the Lee Wilson single stack portable base system.
96	ZURN MFG. CO., J. A.	MANUAL NO. 952	Zurn LPD strainer data.

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PITTSBURGH 22, PA.

The difference between Life... and Death...

"Why should you give blood? Ask me—I ought to know. I fought in Korea. But since then I've been through the biggest battle of all—the battle for life itself. And it was blood—and blood alone—that saved me. Don't know when I'll be in a position to start repaying my debt by giving some blood of my own. But I will—some day. You can count on it!"

All kinds of people give blood—for all kinds of reasons. But every reason for giving blood is a *special* reason . . . just as every American life that can be saved at any time and at any place . . . is special. So whatever *your* reason for giving blood, this you can be sure of: Whether it goes to a combat area, a local hospital, or for Civil Defense needs—this priceless, painless gift will some day save an American life!

Give Blood Now

CALL YOUR RED CROSS TODAY!

NATIONAL BLOOD PROGRAM

Business Executives!

✓Check These Questions!

If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- ☐ Have you given your employees time off to make blood donations?
- ☐ Has your company given any recognition to donors?
- ☐ Do you have a Blood Donor Honor Roll in your company?
- ☐ Have you arranged to have a Bloodmobile make regular visits?
- ☐ Has your management endorsed the local Blood Donor Program?
- ☐ Have you informed employees of your company's plan of co-operation?
- ☐ Was this information given through Plant Bulletin or House Magazine?
- ☐ Have you conducted a Donor Pledge Campaign in your company?
- ☐ Have you set up a list of volunteers so that efficient plans can be made for scheduling donors?

Remember, as long as a *single* pint of blood may mean the difference between life and death for *any* American . . . the need for blood is *urgent!*

200-ton 6-motor 98'-3" Span Crane with two 100-ton Hoists and one auxiliary 10-ton Hoist. In Concentrator Grinding Bay.

DESIGNERS • MANUFACTURERS • CONTRACTORS
BLOOMING MILLS • PLATE MILLS • STRUCTURAL MILLS • ELECTRIC TRAVELING CRANES • CHARGING MACHINES • INGOT STRIPPING MACHINES • SOAKING PIT CRANES • ELECTRIC WELDED FABRICATION • LADLE CRANES • STEAM HAMMERS STEAM HYDRAULIC FORGING PRESSES • SPECIAL MACHINERY FOR STEEL MILLS

BUILT BY MORGAN Engineering

MORGAN CRANES AT "CHUQUI"

Illustrated are three Morgan Heavy Duty Mill Type Cranes at Chile Exploration Company's new plant at Chuquicamata. These cranes are of very rugged construction, especially designed for copper smelter service. *Your inquiries will be appreciated.*

THE MORGAN ENGINEERING CO.

ALLIANCE, OHIO PITTSBURGH—1420 OLIVER BUILDING

100-ton 6-motor 70'-0" Span Crane with two

100-ton 6-motor 70'-0" Span Crane with two

Equipment News...

SMALL ROLLING MILLS

▲ A new concept in design of small rolling mills — with ruggedness and versatility the main objectives — is embodied in a new line of three and four inch rolling mills developed by the Stanat Manufacturing Co. For the first time, mills of such dimensions now incorporate many features formerly associated only with the heaviest type of equipment.

Through the use of standard, interchangeable parts, units can be "tailored" to meet individual requirements, without resorting to complete redesign. Rolls are furnished either flat or grooved to produce a great variety of shapes such as round, square, half-round, diamond, or special shapes for individual requirements. Rolls are also supplied for such purposes as reducing or compacting small tubing sizes. A typical grooved roll in the three inch diameter machine might produce square wire in sizes from 0.250 in. down to 0.040 in., although this is by no means the practical limit. In the 4 in. diameter machine, this range of sizes can be materially increased. By mounting two 4 in. machines side by side on a single base, wire can be rolled from 0.750 in. down to 0.040 in., but reduction ranges can be varied to suit individual needs.

Greater versatility is achieved by mounting standard units in various combinations. Typical groupings are: Two sets of flat rolls, one for roughing, one for finishing; one set of flat rolls and one set of wire rolls; two sets of wire rolls to greatly increase the range of the machine; two sets of flat rolls, one for hot rolling and one for cold rolling. These mills can also be furnished with a built-in bull-block to draw wire, or to provide tension during rolling.

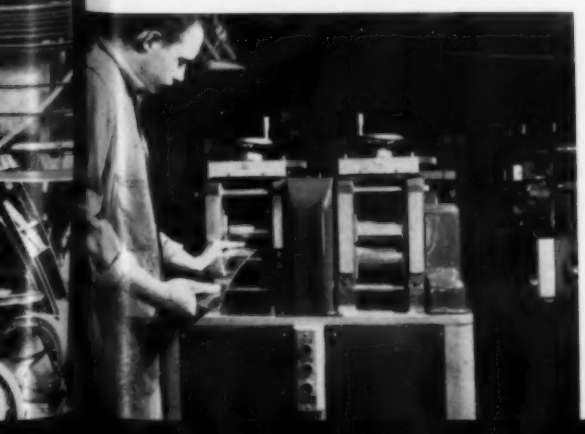
The rugged construction of these compact machines is characteristic of "heavy" equipment design. These features include housings cast of Meehanite type GM alloy to withstand extreme stresses and shockloads. Heavy bronze bearings are completely enclosed within a heavy-duty welded steel cabinet-type base. In addition, 4 in. units are available with roller bearings and can be arranged for water cooling.

The precision adjustment built into these mills makes them the machine of choice to produce material to fine tolerances. Parallelism is maintained by special hardened and ground screws, which can be adjusted individually, or by a single handwheel screwdown. A third type of adjustment using a worm gear screwdown is available for making fine adjustments while the machine is in operation. All units are equipped with large micrometer dials for easy reading.

Rolls are normally supplied of special alloy tool steel, hardened and ground to a high finish. Where requirements call for patterned surfaces, rolls are supplied in the unhardened state so that designs can be engraved in. Special rolls are available for hot rolling, or with mirror finishes.

Their compact design permits these machines to be used in any laboratory setup or production shop where space is at a premium. Groupings were possible so that work formerly done on three machines can now be accomplished by a single mill. Combined with their ruggedness, this feature has earned them wide acceptance among manufacturers of electronic tubes and wires, slide fasteners, tubular heating elements, optical parts, and jewelry. Laboratories and research departments are using them to test the properties of such diversified industrial materials as stainless steel, titanium, plastics, as well as new experimental alloys.

The possibility of marring fine finishes is minimized with these mills, since the upper rolls are driven from the lower rolls through hardened helical gears; thus, gear marks on finished pieces are eliminated. All of these features are incorporated in the complete lines of both the three and the four inch rolling mills.

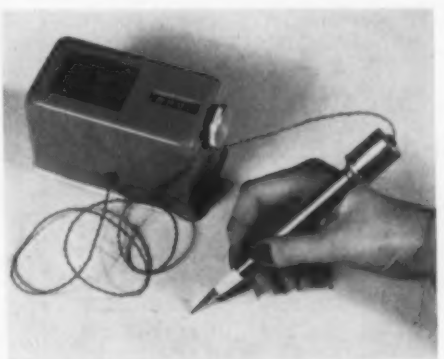


Operator rolling flat stock on combination flat and wire rolling mill. Although this machine is equipped with single hand wheel screwdowns, a wide variety of possible assemblies enables a single machine to do the work of three or four.

MARKING DEVICE

▲ May Engineering Co. is introducing a reliable machine for counting and marking at the same time. The device is called "Mark-N-Count."

The pencil is used to check items or blueprints for estimating purposes. To mark and count certain items in production, taking inventory, checking lists, etc. An audible click registers each count.



The knob is turned for quickly resetting to zero.

The main advantage of using the machine is that concentration on the part of the user is not required and he may actually take part in conversation or other interruptions without making a mistake in counting.

ELECTRICAL FITTINGS

▲ Adalet Manufacturing Co. announces a new addition to its line of electrical conduit fittings. Now available under the Adalet name are "Water-Tite" connectors.

The connectors will fit all standard sizes of service entrance cable and many round cables. Grommets can be furnished in special sizes.

The connector can also be used as

MEET THE BRIGHT, NEW MATHEWS LOADSTAR

A Spectacular Performer in the Fine Trolley Field

This completely new trolley conveyer, designed to meet the requirements of the most discriminating buyer, is the result of five years of intensive development by Mathews Engineers. The top-quality precision wheel, with hardened races, is the heart of this rugged newcomer to the fine 4" trolley conveyer field. For the overhead conveying job that demands stamina and exceptional performance, we believe the No. 4207 Loadstar is without equal anywhere.

Ask your Mathews Engineer for complete information.

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Engineering Offices or Sales Agencies in Principal American and Canadian Cities

a terminal fitting when going from conduit or fittings to open wiring for connecting motors, panel board wiring and similar conditions.

Following its policy of furnishing weatherproof, rust resistant fittings, Adalet offers the connectors in its aluminum alloy material, developed to a high quality level by the company through years of extensive experimentation and research.

AIR-GAS MIXER

▲As part of an extensive modernization program in manufacturing methods to streamline production, undertaken by the Moline Iron Works, Moline, Ill., eleven of their malleable iron annealing furnaces each of 25 tons capacity have been converted from coal to natural gas firing. Six of the furnaces are in plant No. 3 and five in plant No. 2.

Substantial savings were obtained in the cost of gas fuel over coal.

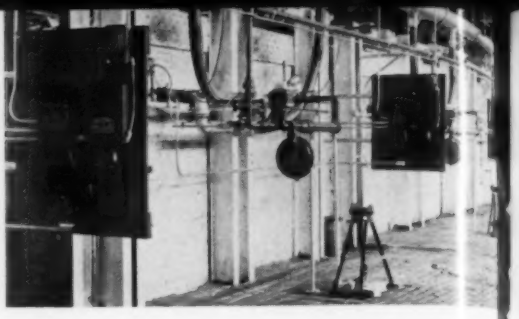
Previously the furnaces had been hand coal fired with the usual attendant variations in performance. Dirty, dusty piles of coal, placed at each furnace, made it impossible to keep the plant clean. Operation was very uneconomical.

After careful combustion engineering survey, the existing furnaces were modified and converted to gas firing with Hauck low pressure air-gas proportional mixers and Hauck "retain-a-flame" burners. The mixers have single valve control. In addition, flame safety equipment, consisting of Wheelco Flame-o-trol units, flame rods, and Hauck spark-gas pilots providing push-button starting of burners were incorporated into the gas burning system. Accurate control of heat input is easily obtained.

The changeover from coal to gas firing, with properly engineered and applied gas burning equipment, has drastically reduced fuel cost, increased output, produced more constant furnace temperature and consequently, more uniformly annealed castings and better quality of work.

A reduction of 24 hours in the firing cycle has been effected. The furnaces are brought up to maximum temperature 20 hours sooner than with hand fired coal heating. Pot life has been increased.

Labor requirements for furnace operation, supervision and maintenance are now considerably less. The atmosphere in the vicinity of the furnaces is much cleaner and more healthful. There has been a decided reduction in furnace repairs. The furnaces have been attractively painted white and aluminum. Soot and smoke are gone. Accumulation of fly ash is no longer a problem, eliminating the necessity for periodic removal of accumulated ashes.



TRAINING COURSE

▲ A new method of training fork lift truck operators in all phases of their trade — operation, maintenance and safety—has been developed by Yale & Towne Manufacturing Co.'s Materials Handling Division.

For more than a year-and-a-half, Yale engineers and maintenance men worked with other experts — skilled fork truck operators, editors, college professors and representatives of the National Safety Council—to develop a course which would be both thorough and practical.

The result is a training program which is equally useful in teaching beginners to become skilled operators in a short time and in refreshing experienced operators on the fine points of their trade.

The course, a valuable contribution to materials handling know-how and safety in industry, is available from Yale.

"Yale's operator training program has been so thoroughly tested and successful," says Elmer F. Twyman, vice president of Yale & Towne, "that we predict it will become the standard training course for fork lift truck operators."

"It has been tested critically in plants and warehouses—both large and small," says Mr. Twyman, "and has proved to be the best way both of teaching new operators and of increasing the efficiency of trained personnel."

The course consists of lessons grouped together as a full plan of instruction or presented in parts, each section an individual whole in itself.

Section One describes the opera-

tion of gasoline, diesel and electric trucks from starting the motor to expert operation.

Section Two provides information on preventive maintenance for all three types of trucks and gives practical daily, weekly, monthly and annual check lists.

Section Three, "Let's Play It Safe," uses instructive cartoon technique to elucidate safety problems in handling fork lift truck and its valuable loads.

For the trained operator, the handbook and manual serve as unparalleled reference material.

Directions for setting up meetings and conducting training classes are included in an instructor's manual, which also provides "Tell them" and "Show them" hints for each lesson. Practice operating courses, indicated in suggested layouts, are easily set up in any plant or warehouse and facilitate practical training in all conventional uses of fork trucks.

Also fully illustrated and clearly explained are constructive hints on loading, estimating cargo weight, lifting and maneuvering. Safety rules and precautions are discussed in lucid detail, enabling the student to not only follow the rule but to understand the reason behind it, an important function of the course. At the end of the course a safe-driving performance test permits the instructor to grade students on an impartial basis.

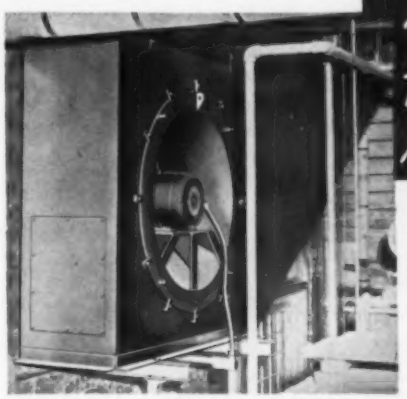
LEAK DETECTOR

▲ General Electric's halogen-sensitive leak detector has been redesigned to permit easier detection of leaks in closed systems, according to a recent announcement by the company's meter and instrument department.

The portable G-E instrument, introduced five years ago, can detect a leak so small that only $\frac{1}{100}$ oz of gas will pass through the opening in a year. It has gained wide acceptance in testing for leaks in refrigerator and air conditioning systems, tanks, boilers, piping, and other products that must be leak proof and into which a halogen gas can be introduced as a tracer.

In the redesigned equipment, a loudspeaker has been built into the control unit for audible indication of leaks. The new device also features an automatic balancing circuit to

Announcing
The WING Package—
DRAFT INDUCER
FOR POWER PLANTS

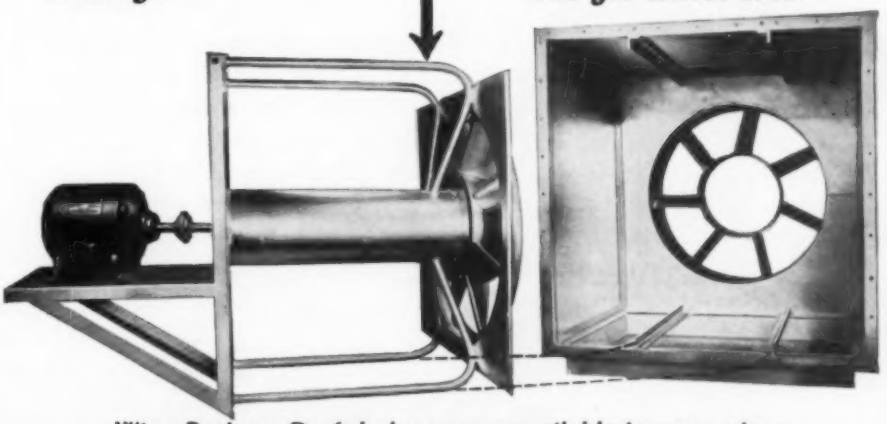


Motor (or Turbine) and Fan in one complete removable unit

In this new high-pressure "Package" Draft Inducer, the motor (or turbine) and fan unit, completely independent of the casing, makes installation considerably easier, and being easily removed, facilitates inspection and maintenance.

ADVANTAGES

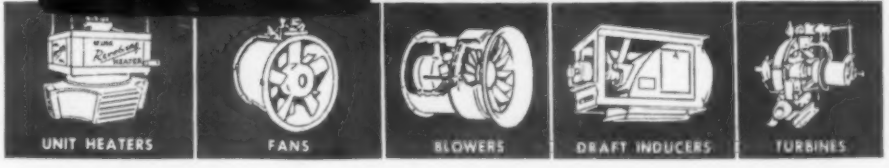
1. Big saving in space requirements
2. Compactness permits fewer and lighter structural supports
3. Eliminates field line-up problems
4. Eliminates water cooling
5. Only two supporting bearings
6. Wide flexibility in gas inlets
7. All moving parts quickly and easily accessible
8. Saves on investment and maintenance
9. Low load ratings on natural draft because of Wingfoil Fan and ample free gas travel area



Wing Package Draft Inducers are available in many sizes with either turbine or electric motor drive. For further information write

Wing

L. J. Wing Mfg. Co.
142 Vreeland Mills Road,
Linden, New Jersey
FACTORIES: Linden, N.J. and Montreal, Can.



Here's how to store more power in the same battery space!

...use C&D electric truck batteries

Your trucks will have more power, work stronger and last longer, when equipped with C & D Slyver-Clad* industrial truck batteries.

Ten years ago, C & D pioneered the Five-Fold method of insulation and retention to hold the active material in place on the positive grid and to practically eliminate sedimentation. This reduced size of the sediment space and allowed the use of longer and heavier plates. In C & D Slyver-Clad batteries, you get 20% more capacity—*in the same-size tray!* And, because "shedding" is also virtually eliminated, a C & D Slyver-Clad Battery lasts longer and delivers maximum capacity at the very end of its life. The next time you replace an industrial truck battery—*install more power in the same space*—install C & D!

*TM Reg.

WRITE FOR SPECIFICATIONS!

For complete descriptions and specifications of C & D Slyver-Clad Industrial Truck Batteries, write for Bulletins IT-517 and IT-518.

C&D

BATTERIES, INC.

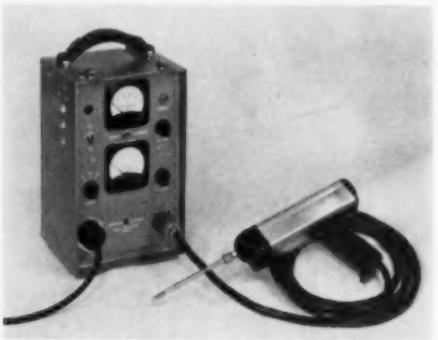
of Conshohocken, Pa.

Manufacturers of Industrial Batteries since 1906

SALES AND SERVICE OFFICES IN PRINCIPAL CITIES FROM COAST TO COAST

compensate for changes in background air contamination. Incorporated in the control unit is a new lightweight, internal voltage stabilizer. The former model required an external voltage stabilizer.

The detector retains the features made popular in the former model, such as the earphone plug and the instrument indication of leaks. Now, however, leak indication can be simultaneously indicated by means of the dial, earphone attachment, or through the built-in loudspeaker.



Shown is a new compact leak detector. The redesigned "sniffer" is able to detect leaks in closed systems, such as refrigerants, water coolers, and many other industrial and commercial items.

The detector equipment consists of a pistol-like "sniffer" and a 17-lb control box about the size of a portable typewriter. It is well suited for assembly-line use as well as for service testing in the factory and in the field.

There are many and varied applications for the detector, according to G-E engineers. It has been used to check for leaks in refrigerator and air conditioning systems, tanks of all sizes, transformers, bellows, compressors, condensers, piping systems, radiant heating systems, valves, and even footballs and basketballs.

FREIGHT PROPOSAL

▲ A possible solution to the nation's crippling highway traffic glut was offered recently. In a statement, William A. Bauer, board chairman of Baker-Raulang Co., described a unique "piggy back" system of freight transport which he says could substantially lower the number of over-the-road shipments and allow more room for passenger car travel.

"The piggy back idea," he said, "teams up railroad flat cars with highway trailers for inter-city freight hauls. Instead of being driven over

"...Upwards of 80 per cent of all Gulf Oil employees..."

S. A. SWENSRUD
President, Gulf Oil Corporation

"I have no hesitation in saying I believe it is a sound thing for our industry to support the Government's Payroll Savings Plan and to encourage our employees to put at least a substantial part of their savings into U.S. Savings Bonds. Upwards of 80 per cent of all Gulf Oil employees save part of each pay in E Bonds. This type of thrift is good for the nation as well as for the individual."

At the close of 1952–

- Individual Americans owned Savings Bonds totaling more than $49 billion, cash value.
- Series E Bonds outstanding—the kind bought by Payroll Savers—were more than $600 million greater than on May 1, 1951, when the bonds issued in 1941 started to mature.
- Of the $4.8 billion Series E Bonds which matured between May, 1951, and December, 1952, more than $3.6 billion (75%) were held beyond maturity, under the automatic extension plan.
- More than 77 million units of Series E Savings Bonds were bought by individuals in 1952—13% more than in the previous year.
- During every one of the past 21 months, redemptions of unmatured Series E Bonds have been well under 1% of the total amount outstanding.
- 1953 figures should be even better—more than 1,000,000 Americans joined the Payroll Savings Plan in 1952, and thousands, literally, are enrolling every day.
- Never before in the history of this or any other country have employed men and women held a reserve purchasing power of $49 billion in government securities—a cushion against emergency, a check on inflationary tendencies.

If you believe with Mr. Swensrud that "it is a sound thing for industry to support the Payroll Savings Plan . . ." and ". . . this type of thrift is good for the nation as well as the individual," phone, wire or write to Savings Bond Division, U. S. Treasury Department, Washington, D. C. Your State Director will show you how your participation can be raised to 60%, 70% or even higher.

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IRON AND STEEL ENGINEER

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RED CIRCLE Rolls ALLOY-CHILLED

Red Circle Rolls for all Purposes

Hyde Park Red Circle Rolls are outstanding in quality and in performance and are easily identified by the Red Circle.

for
finer finish
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greater tonnage
Specify Red Circle

Chilled Rolls
Alloy Iron Rolls
Moly Rolls
Nickel Chilled Rolls
Grain Rolls
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Hyde Park
FOUNDRY & MACHINE CO.
Hyde Park, Westmoreland County, Pa.
ROLLS
ROLLING MILL MACHINERY
GREY IRON CASTINGS

already jammed roadways, loaded trailers are put on flat cars and moved by rail—where they do not compete with commuter and tourist traffic."

Mr. Bauer stated that Baker-Raulang was designing and testing equipment to pick up truck trailers and placing them on cars.

The apparently radical shipping method has been tested and found workable, he claimed. "As a matter of fact, the New York, New Haven and Hartford moves more than 500 semi-trailers each week on piggy-back, and the system is now used to a limited extent to bring milk into New York City. Two other major railroads — Chicago Great Western and the Denver and Rio Grande—are making piggy-back runs."

"Rail carriers say the system has been profitable both for themselves and for highway shippers who have participated."

Bauer pointed out that about 400 semi-trailers leave Pittsburgh daily for New York and other large freight traffic centers. Similar numbers rolling out of important terminal cities have added to the locust-swarm of vehicles on our highways, he continued, until today "pleasure driving" is a soured joke to big-city car owners.

"One large highway shipper estimates his overland hauls would be cut by at least 30 per cent with the piggy-back method. A shortage of flat cars has been the main deterrent to his participation in the system."

"Piggy-backing is attractive to many shippers because it would combine the flexibility of truck operations in terminal areas with the speed and economy of long-haul transportation by rail."

"Interest in this new technique is growing," he declared. "One railroad even is considering the possibilities of mounting regular highway trailers so they can be assembled into trains and moved on rails — using their own wheels."

While this development will probably not gain significant proportions immediately, the system of loading highway trailers onto flat cars is considered by transportation experts to be an eminently realistic one.

WELDING ELECTRODE

▲ Air Reduction just announced the availability of a new, improved E6010 electrode, the Airco 78E, for welding mild steel in all positions.

This new electrode offers deep penetration without undercutting, a minimum of spatter, and uniform weld deposits without fingernailing. The deposit solidifies quickly which especially adapts this electrode for welding in the vertical and overhead positions.

The electrode is recommended for the fabrication of mild steel involving plate and rolled sections or castings, fired and unfired pressure vessels, structural frames, pipe lines and all classes of marine work where high ductility and tensile strength are essential.

PUMP MOTOR

▲ Horsepower ratings of totally-enclosed and explosion-proof vertical pump motors have just been increased to 75 hp by U. S. Electrical Motors, Inc. Available with either hollow shaft or solid shaft construction, these motors are designed for power-

ing turbine pumps in refineries, sewage disposal plants, dangerous, dusty or dirty locations.

These explosion-proof vertical motors are designed to comply with Underwriters' specifications for Class I —Group D, highly inflammable gases and volatile liquids and Class II—

Groups F and G,, for combustible dusts. The totally-enclosed vertical motors are ideally suited for service in plants or locations where non-explosive conditions prevail, for protection against non-combustible dust, dirt, moisture, abrasives and corrosive-forming drippings. Both type motors are double-enclosed for fullest protection with generous size built-in fan for rapid heat dissipation.

These motors embody the many features of the standard U. S. turbine pump motor: adjustable hollowshaft, reverse protection clutch, die-cast rotor, lightweight aluminum canopy cap, dynamic balancing, backstops optional, asbestos-protected windings, Lubriflush lubrication and normalized castings.

LOAD CONTROL UNIT

▲ An improved load control regulator for diesel-electric locomotives is available from Westinghouse Electric Corp. The new "Commustat" regulator automatically insures constant loading of the diesel engine over the normal range of operating speeds and matches the output of the generator to the power the engine can produce.

The regulator employs a hydraulic cylinder, the piston of which is linked to a brush arm that rotates about a stationary commutator. Individual bars of the commutator are connected to tapped resistor tubes. The position of the hydraulic cylinder determines the value of resistance in the exciter battery field. A pilot valve mounted on the diesel engine governor and operated by the governor fuel-control arm controls the flow of oil to and from the load regulator cylinder.

Load regulators for passenger or all-service locomotives are equipped with an air actuator to provide a "soft start."

The new regulator utilizes tapped vitreous-enameled resistor tubes. Resistance of these tubes remains constant and is not affected by dirt or vibration. An improved pilot valve requires only routine adjustment and maintenance. The metering valve used on the superseded carbonstat regulator and earlier models of the regulator has been eliminated.

The new regulator is suitable for replacing existing carbonstat regulators and kits are available from Westinghouse for modernizing earlier

THIS PICTURE TELLS A STORY of a new cost-cutting opportunity for steel mills

Note the ready accessibility of each item of steel in this storage yard of a well-known steel mill. It's this availability of materials that's one of the prime advantages of the ROSS STRADDLE CARRIER handling method . . . an advantage, unmatched by any other method, that eliminates delays, lowers costs and increases the production efficiency of the mill.

ROSS STRADDLE CARRIERS, heart of the Ross unit-load handling system, are built to handle 45,000-pound concentrated loads on around-the-clock schedules in the roughest, toughest steel mill service . . . to put those loads *where* wanted *when* wanted.

Your mill, too, can profit by this modern, flexible mass handling system. Get in touch with Ross today for the complete details.

Rely On ROSS

THE ROSS CARRIER COMPANY

Direct Factory Branches and Dealers Throughout the World

400 MILLER ST., BENTON HARBOR, MICH., U.S.A.

models of the "Commustat" regulator.

RECEPTACLES AND PLUGS

▲ An Ohio manufacturer of lathes and other machine tools is using 250 "Arktite" receptacles and plugs, manufactured by the Crouse-Hinds Co., to speed up assembly and testing methods.

The Monarch Machine Tool Co., has a power distribution system that enables 135 lathes to be handled simultaneously in various stages of assembly.

Resembling a mammoth telephone switchboard and operated fundamentally in the same manner, the new installation allows almost immediate changes in power requirements at testing stations located one floor above it. Also, because these plugs are designed to enclose tightly the electric arc until it is broken, they may be inserted and withdrawn at will from "live" receptacles without using additional disconnect equipment.

Since lathes are produced for both domestic and foreign consignment by Monarch, not only must a-c and d-c power be available for test purposes, but a number of voltages in both services as well. One, two and three-phase a-c power in several frequencies is also required. Rather than to restrict the assembly of lathes for foreign delivery to special assembly stations, all stations have been supplied with Crouse-Hinds receptacles in floor outlet boxes through which any desired combination of the foregoing electrical services can be obtained.

ANGLE GRINDER

▲ Ingersoll-Rand Co. introduces a new air-powered, direct drive angle grinder. Its advanced design eliminates the need of bevel gears, or gears of any kind. The new angle grinder has enough power to provide fast, safe, and efficient operation on practically all surface grinding, cut-off and sanding jobs. Speed, at 90 psi air pressure, is 6000 rpm.

Two types of dead handles are available for this new grinder, one is straight and the other is 30 degrees off of straight. These handles may be attached to either side of the grinder, and the angle dead handle may be rotated to any one of four positions. This means that the tool can easily be adapted for corner grinding or for right or left handed operators.

A built-in lubricator provides ample lubrication for long, trouble-free service. The motor is effectively muffled to reduce noise, and the exhaust deflector is adjustable to deflect the

"HEADQUARTERS" FOR RADIANT TUBES

The "life expectancy" of Radiant Tubes has been so extended by National Alloy that they now are the most widely used and *least expensive* tubes available. If frequent furnace shutdowns and tube replacements have boosted your heat-treating costs it will pay you to consult with National Alloy . . . for a picture story of our products and procedures write for Bulletin No. 2041.

BLAW-KNOX

BLAW-KNOX COMPANY
NATIONAL ALLOY DIVISION
BLAWNOX, PA.

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STEEL PLATE CONSTRUCTION

DISTILLATION CYLINDERS
9'-0" DIAMETER • 126'-0" LONG • 131,000 LBS. EACH.
EACH CYLINDER SHIPPED IN ONE PIECE

HOMOGENEOUS LEAD LINED EQUIPMENT
OPEN HEARTH AND HOT METAL LADLES
STEEL PLANT TRANSFER CARS
HYDRAULIC GATES
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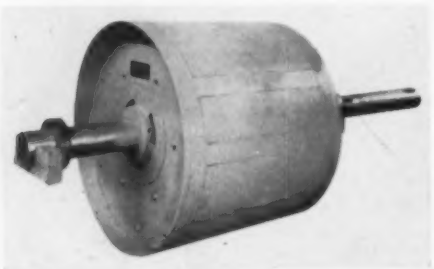
exhaust away from the operator. Heavy-duty ball bearing construction throughout reduces friction to a minimum, while a quick-acting throttle makes this grinder easy to use.

MAGNETIC PULLEY

▲ Stearns Magnetic, Inc., has built what is considered to be one of the largest, most powerful permanent magnetic pulleys ever made. (42 in. diameter, 38 in. crown face, 36 in. belt width).



Made of "Alnico V" the Stearns pulley is designed to process run of mine coal up to 10 in. lump size at a belt speed of 300 fpm with a capacity of 300 tons per hour.

PYROMETER

▲ A single-point, double-range indicating millivoltmeter pyrometer, incorporating a newly designed plug-in galvanometer, has been developed by the Industrial Division of Minneapolis-Honeywell Regulator Co.

The new dual temperature indicator is said to be more stable in operation, relatively free from the effects of vibration and temperature and more easily serviced than earlier types of millivoltmeters. Two combinations of ranges (0 to 2400 F and 0 to 3000 F, and 0 to 2000 F and 0 to 3000 F.) will be offered as standard. Other combinations will be supplied on a special basis.

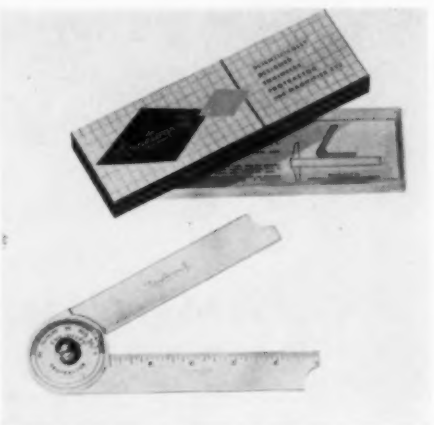
Housed in a die-cast aluminum case, the new instrument has two compartments each with separate covers. The upper compartment contains the plug-in galvanometer unit. It is totally enclosed to protect the calibrated measuring systems and the scale and pointer from dust and foreign particles. Terminal connections are in the lower compartment. These are completely accessible upon removing the cover.

For each combination of ranges, a different galvanometer is supplied, incorporating different combinations of springs, bimetallic spirals, and span adjusting resistors. Two such resistors are provided, each connected to form a separate measuring circuit for each range. Thermocouples are the detecting element for the new double-range indicator.

PROTRACTOR

▲ An all new concept in adjustable, engineers protractor design and adaptability has been announced by the Way-Mac Manufacturing Co. Called the "Tractograf," it is a miniature drafting machine in itself. This precision instrument will be of unusual interest to engineers, draftsmen, architects, artists and students.

Any number of angles, from zero to 180 degrees can be drawn instantly without turning, sliding, or moving the protractor out of position at any time. Simply swing upper rule arm to desired angle and lock adjustment



knob. A magnifier, built-in over the registration mark, gives clear, hairline adjustment every time. Dial is white and easy to read. The 180 degree arc is calibrated in sharply defined 1 and 5 degree divisions.

In addition, usually forgotten but often needed mathematical formulae are printed on the reverse side of the calibrated dial. A handy 5 in. rule on the lower arm is also an added convenience.

The new "Tractograf" is made from clear, lifetime plastic with smoothly machined and bevelled ruling edges for fast and accurate work. It is 2 in. wide and 7 in. long when set at zero, it is handy for shirt or coat

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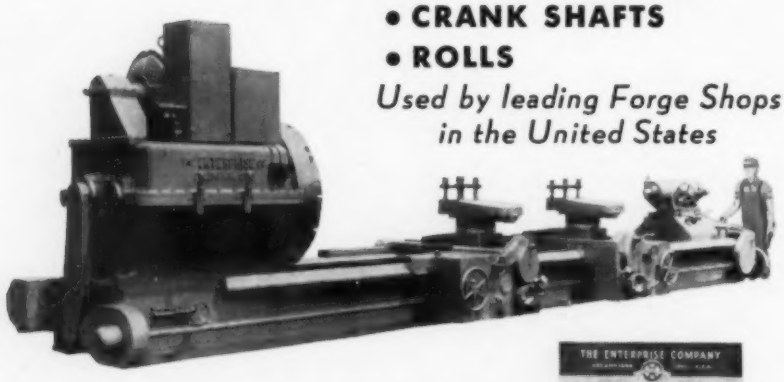

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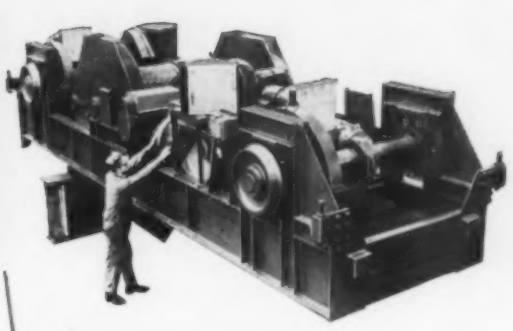
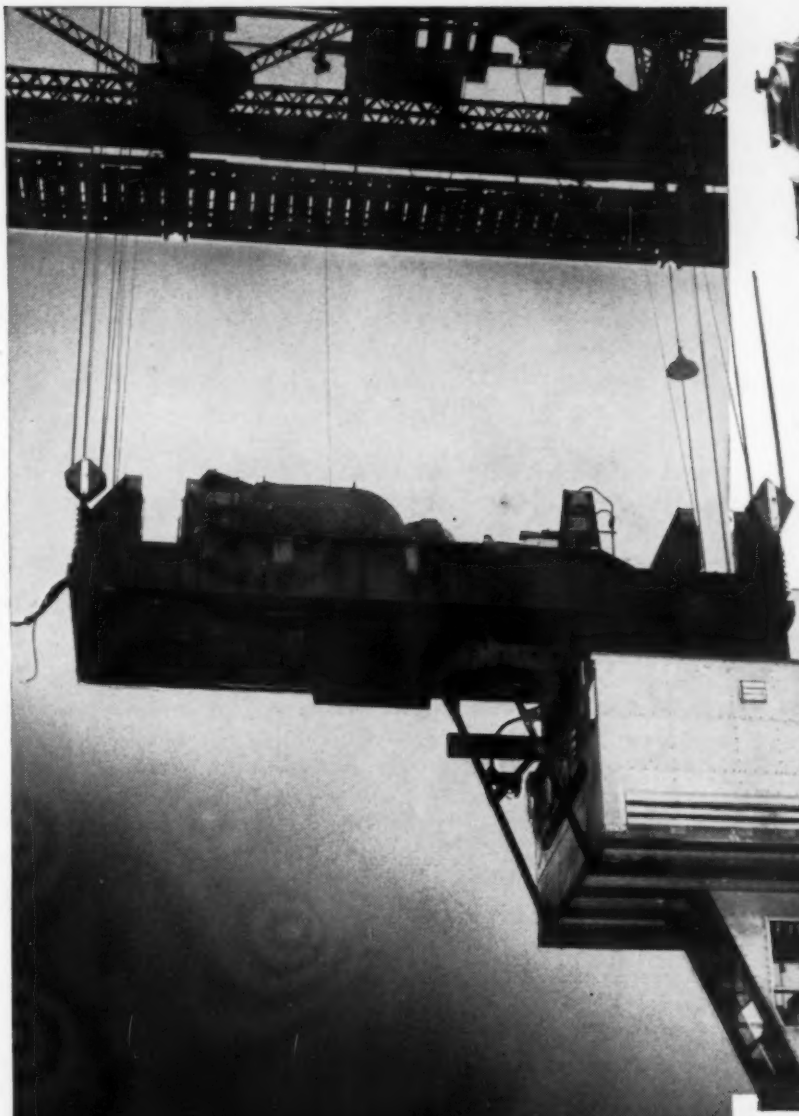


Step up your bridge capacity with a new Dravo Man Trolley..



Is your production slowed down because your bridge can't handle the tonnage you need?

Actually, it isn't always necessary to invest in a new bridge to correct this lag. Often an existing structure can be modernized easily by replacing the present man trolley with a light-weight Dravo-built unit.

The operation is practical and requires a minimum of bridge-downtime. One recent installation was completed within eight hours.

Replacement of inefficient, worn or inadequate trolleys can improve your operations at a fraction of new bridge cost. Consultation with a Dravo engineer does not obligate you in any way—and may help you eliminate a production bottleneck. Write or phone . . .

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pocket. With ordinary care the machine should give many years of satisfactory service, according to the manufacturer.

ALLOY PIPE WRENCH

▲ An extremely light weight aluminum alloy pipe wrench with removable beryllium-copper jaw inserts is the latest addition to the line of Ampco safety tools produced by Ampco Metal, Inc.

Forged of an aluminum alloy, this spark-resistant wrench possesses a dense uniform grain structure with excellent physical properties. Its tensile strength is comparable to that of steel tools. Extremely light, its weight range is from 15 oz for the 10 in. size to only 128 oz for the 36 in. size.

An economy feature — the beryllium-copper jaw inserts are removable and interchangeable. When the teeth become worn, merely remove the insert and reorder from stock at a fractional cost. Removable jaw inserts made of steel can also be supplied where the spark-resistant, corrosion-resistant and non magnetic properties of beryllium-copper are not required.

ALUMINUM WINDINGS

▲ Distribution transformers with aluminum windings can be built with approximately the same characteristics as the present copper designs, Raymond W. Smith, general manager of the General Electric Co.'s distribution transformer department, announced.

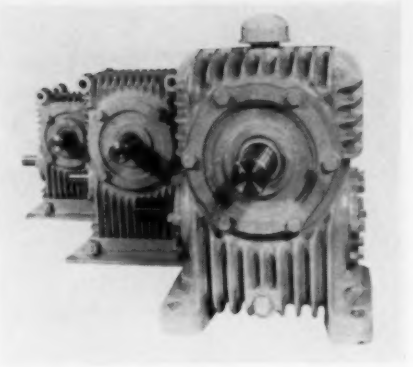
Mr. Smith said, "This will enable the company to meet customers' need if there is any future shortage of copper or a marked increase in its price, compared to aluminum."

In spite of the lower conductivity of aluminum and increased manufacturing problems, distribution transformers in a number of ratings have been produced using aluminum windings with the overall weight, dimensions and electrical characteristics practically identical to copper transformers, he added.

The company does not plan to shift to the use of aluminum at this time, Mr. Smith emphasized. However, several hundred development and production transformers with aluminum windings have been built in sizes 5 to 333 kva for voltage classes of 15,000 volts and less. Many of these transformers are now operating on customers' lines and plans are to continue a small experimental production.

SPEED REDUCER

▲ A line of standard double-enveloping worm gear speed reducers, ideally suited for iron and steel industry equipment power drive applications, is available from Cone-Drive Gears Division, Michigan Tool Co. These reducers feature double-enveloping worm gears that permit extremely high-load carrying capacity for a given size because of the large number of worm teeth in continuous area contact with the gear teeth. Double-enveloping worm gear speed reducers — with the gear enveloping the worm and the worm enveloping the gear — are claimed to carry 2 to 3 times the load of conventional worm gear speed reducers of the same size.

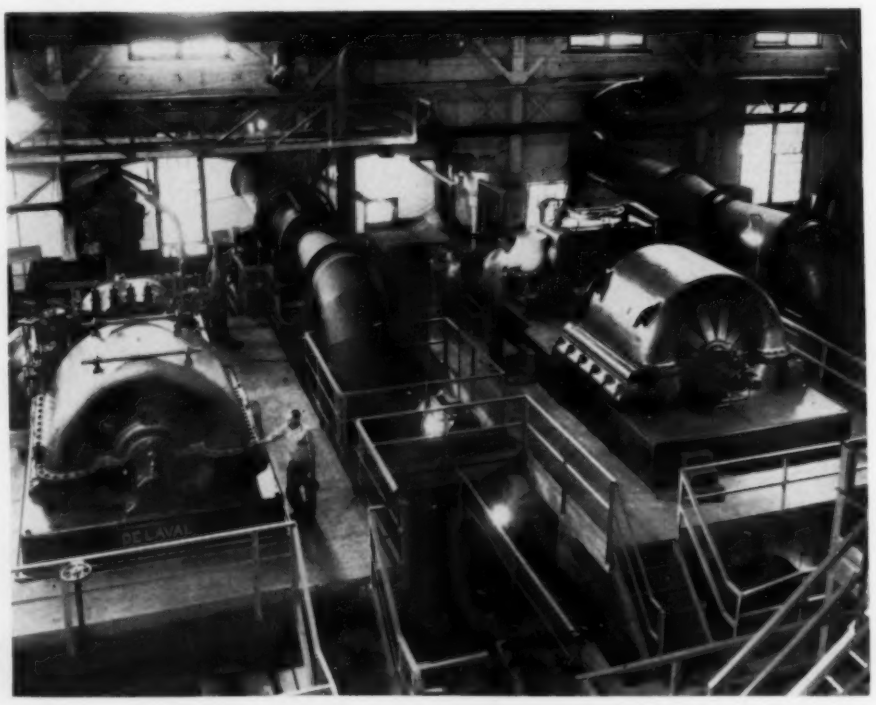


The resulting compactness, high load carrying capacity, resistance to shock loads, high safety factor, low cost and long wear life of these reducers makes them ideal for power drive applications in iron and steel industry equipment such as furnaces, cooling beds, blooming mills, merchant mills, rolling mills, tubing mills, chargers, slitters, shears, roll breakers, pusher drives, ore bridges, hoists and materials handling equipment.

Cone-Drive cast iron reducer housings have thick walls and are reinforced with internal ribbing at strategic points. External cooling fins provide maximum cooling where needed and also strengthen the housing. The

NEW BLOWER JOINS 25-YEAR-OLD UNIT

Twenty-five years ago, the Machinery Division of Dravo Corp. installed the big turbo-blower at the left for the Carnegie Steel Co. Recently, Dravo added the second one (right) for the Sharon Steel Corp., who purchased the Farrell Works in 1945. A duplicate of the first, the new blower is a 7000-horsepower unit capable of delivering 60,000 cubic feet of air a minute at 30 pounds per square inch. Both blowers, which supply air for blast furnaces, were manufactured by the DeLaval Steam Turbine Co., a firm Dravo has represented for 52 years. The original unit was Dravo's and DeLaval's first blast-furnace blower for the steel industry.



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THE NEW "SA-FUSE" CONTROL

Fuses are *Dead* and *Grounded*

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THE OLD . . . STANDARD CONTROL. Fuses are Live and operator is Exposed to High Voltage When Fuse Compartment is Opened. Hook-Stick Always Needed.

The fuses in the "Hi-Fuse", High-Voltage, High-Interrupting Capacity Motor Control above are being handled with the following safety assurances: (1) *that the fuses are completely disconnected from the circuit,* (2) *that the fuses are grounded,* (3) *and that a heavy insulating barrier shields the operator from high voltage.*

These new important safety features are now provided by the new SA-FUSE compartment for Hi-Fuse Control. When the fuse door is opened, a gang-disconnect separates the fuse panel from the high voltage circuit and brings the fuses up in safe, convenient reach. The fuses can then be quickly inspected or replaced.

Hi-Fuse Control with the SA-FUSE Compartment is an economical, highly protective control. It is the kind of modern motor control you will want in your plant because it is a forward step in providing security from high voltage hazards. The E-M Sales Engineer near you will be glad to give you complete information.

Be sure to write for E-M Bulletin No. 211 and E-M Foto-Facts No. 21, which show step-by-step illustrations of SA-FUSE operation.

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15-in. and 18-in. reducers have welded steel housings with internal welded web plates for reinforcement.

The chrome-moly nickel steel pinion and chill-cast copper tin nickel bronze gear are supported by anti-friction bearings. Splash lubrication and wear resistant plastic shims are also provided in standard Cone-Drive speed reducers.

Gear sets, shafts, bearings, mountings, etc., are interchangeable between all types of reducers of a given size, regardless of ratio or cooling method, thus simplifying maintenance and reducing cost of any necessary replacement parts.

Standard Cone-Drive speed reducers are designed to operate with the pinion under or over, or the gear shaft vertical. They are available in a wide range of sizes and models, including fan-cooled and water-cooled heavy-duty types as well as double reduction units.

Capacities of the models range from fractional to 800 hp with center distances from 2-in. to 18-in. Larger sizes can be had on special order. Reduction ratios range from 5/1 to 70/1.

CHARGING UNIT

▲ The "Manipulet," designed and built by Salem-Brosius, Inc., meets the forging industry's demand for a light-weight, low cost machine for manipulating hot forging stock in hammer or press operations. The unit embodies a new principle in manipulation, furnace charging and drawing, and hot stock handling of forging stock up to 1500 lb. in weight. Built in two capacities, the 500 series and the 1500 series, the unit is a light-weight, low cost adaptation of the famous Salem-Brosius auto floor forging manipulator, used in forge shops throughout the world.

The new manipulator converts a standard lift truck into a forging manipulator by incorporating into its design an hydraulically actuated manipulating apparatus. The entire manipulating mechanism is mounted on the elevating tracks of the lift truck. The truck becomes an integral part of the manipulet, serving as a carrier and providing hydraulic power.

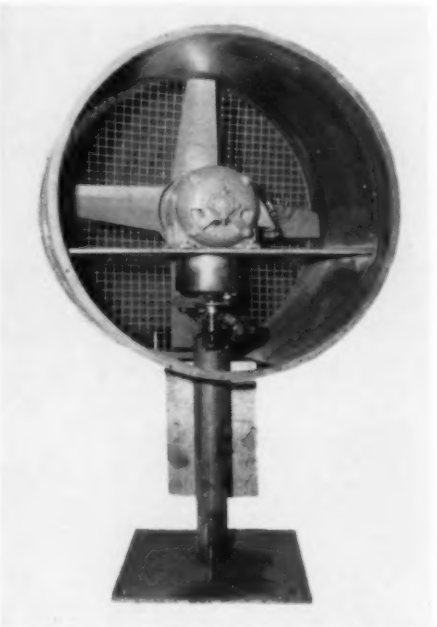
Design of the shock absorbing system is an ingenious method of counteracting and counterbalancing shocks transmitted to the truck from hammer blows on the workpiece. Stabilizers, backed by heavy coil springs, are mounted on the front of the machine. From the outer edges of the main frame, along either side of the lift truck, are suspended counterweights. Shock transmitted from the peel and work-head are absorbed by both of these units, the former by compression of the coil springs and the latter by a torque bar effect. The counter weights serve the additional purpose of moving the center of gravity of the loaded vehicle rearward, thus giving the vehicle greater load stability and improving the distribution of stresses. The shock absorbing system also improves operator comfort.

One man operating the unit does the work of two, three and often four men usually required for forging manipulator crews — and he does it faster and with greater personal comfort. Hammer operations can sometimes be speeded up by 150 per cent, because the use of cranes, slings, porter bars and other auxiliary equipment becomes unnecessary. The smooth, fast, effortless handling of forging stock by the machine assures savings in time, overhead and maintenance.

Lift trucks of practically any manufacture, with solid rubber tires and some type of an automatic, clutch-less transmission, can be used. Both the lift truck and the manipulating apparatus have ample overload safety margins to provide a rugged, serviceable and durable machine for continuous, hard use.

OSCILLATING FAN

▲ Robinson Ventilating Co. is announcing the addition of a power driven, oscillating man cooling fan to their line of conventional cooling fans.



As in their standard man cooling fan, this unit has a fabricated steel propeller mounted on the shaft of a totally enclosed, ball bearing motor. The most common size has a 36 in. propeller with a 1 hp, 1200 rpm motor.

The oscillating mechanism is driven by a gear head motor which is mounted on the fan pedestal and connected through an operating arm to a ball bearing equipped motor base. The fan oscillates through an arc of approximately 60 degrees — that is 30 degrees each side of the center line, at a speed of about ten times per min.

The entire operating mechanism is protected by a cylindrical casing, fitted with a woven wire guard at front and rear.

The fan assembly may be mounted on the floor or suspended in an inverted position from the ceiling or an overhead platform. The design permits the fan to sweep a wide area with cooling air.

(*Please turn to page 214*)

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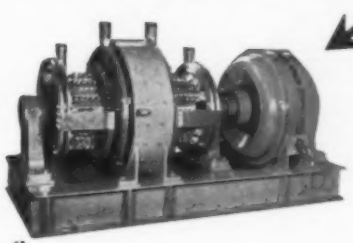

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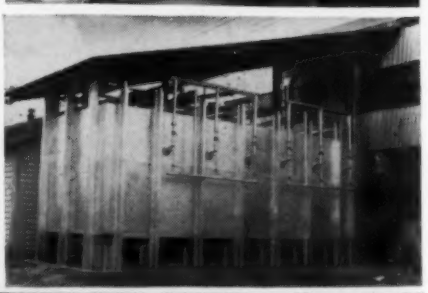
Interior view after lining. Furnace operates to temperatures of 1800 F.



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Including complete filtering for excessive dusts and gases, these Aire-Rectifiers meet the requirements perfectly of cranes in these temperature ranges.

Thus, they make possible substantial savings, because of their lower costs, as compared with larger units planned to handle the requirements of higher temperatures.

Designed for the heavy demands of industrial service, these new Aire-Rectifiers are sturdily built. They are equipped with all copper coils, oversize motors, and heavy duty controls. Not to be compared with the ordinary commercial unit, they offer the rugged dependability typical of the larger units.

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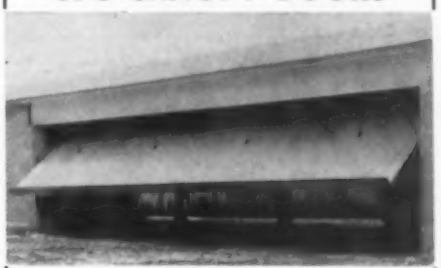

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A fast-growing steel producing company is expanding its organization. We are interested in long-term development of facilities and to help carry out program will require young aggressive . . .

Civil Engineer
Project Engineer
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Foreman, Diesel Cranes and Locomotives

Give full details of experience and salary expectation. Replies will be held in strict confidence.

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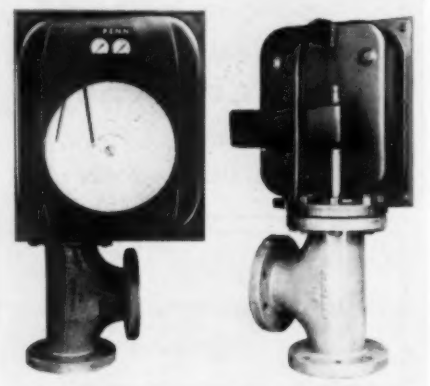
EQUIPMENT NEWS
(Continued from page 208)

FLOW METER

▲ The "Linameter," manufactured by Penn Industrial Instrument Corp., variable area type flow meter, is now furnished with pneumatic transmission. The instrument is fundamentally linear and the air output signal varies directly with rate of flow. (Output range 3-15# standard, other ranges available.)



The meter is an all metal, sturdily constructed instrument operating on the rotameter principle. The instrument is mounted directly in the pipe line like a valve and is suitable for measuring rate of flow of liquids, vapors or gases from 0.3 to 3 gpm minimum flow range to as much as 120 to 1200 gpm maximum. (Corresponding gas or steam flows depend upon pressure and temperature conditions.) It is produced in sizes from 2 in. to 8 in. with a wide choice of materials for meter bodies and internal metering components.

The instrument has a metering float which rides vertically up and down in a tapered metal metering throat inside the meter body. The connection between the metering float inside the flow stream and the instrument components outside is magnetic — there are no stuffing boxes or pressure tight bearings — and it is completely frictionless.

men over 45

More than six times as many men of your age will die of lung cancer this year as died in 1933, according to official reports. Though our research scientists are making every effort to discover the reason for this increase, they still don't know the answer.

They *do* know, however, that the lives of over half of those who will develop lung cancer *can* be saved...if they get proper treatment while the disease is still in the silent stage, before any symptoms have appeared. That is why we urge you to have a chest X-ray every six months when you have your regular health check-up . . . no matter how well you may *feel*. Only an X-ray can detect the "silent shadow". It is your best insurance against death from lung cancer.

For more information about this or any form of cancer, call our nearest office or simply address your letter to "Cancer" in care of your local Post Office.

American Cancer Society

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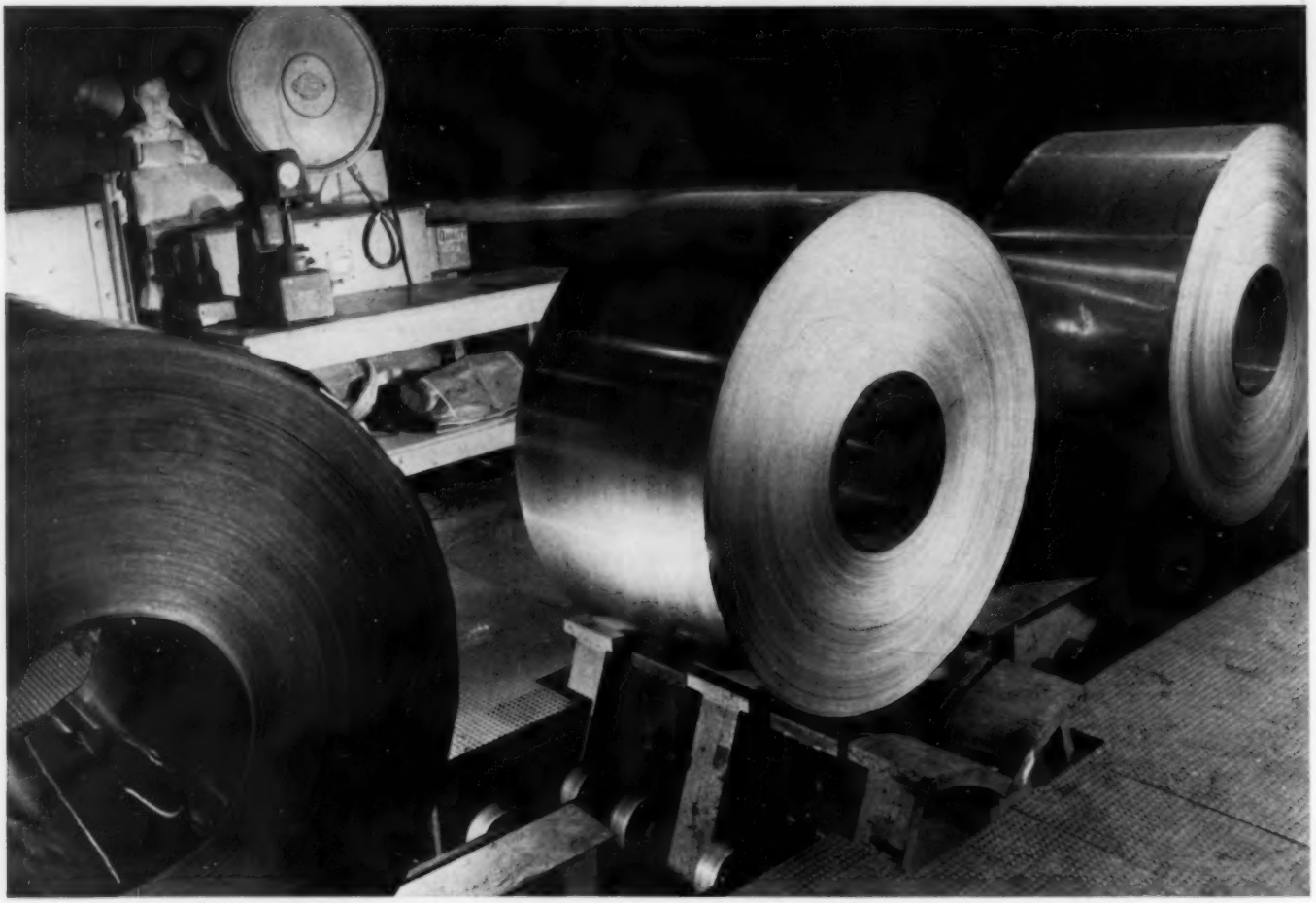


Precise weights of up to 40,000-lb. coils are recorded as they move along Link-Belt saddle top conveyor at temper mill delivery end.

Why Jones & Laughlin again selected LINK-BELT coil conveyors

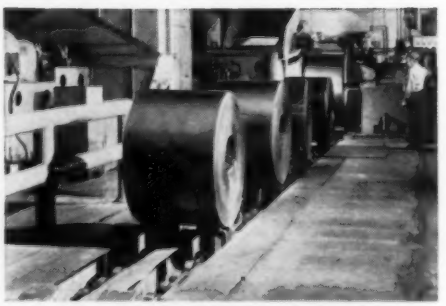
Yield goes up . . . waste goes down handling 40,000 lb coils

HERE'S one mill that knows from experience how effectively Link-Belt conveyors cut coil handling costs. So pleased has Jones & Laughlin been with Link-Belt performance on their pickle line and five-stand tandem mill installed in 1948 that they again chose Link-Belt coil conveyors for their newest temper mills, cleaning and shearing lines.

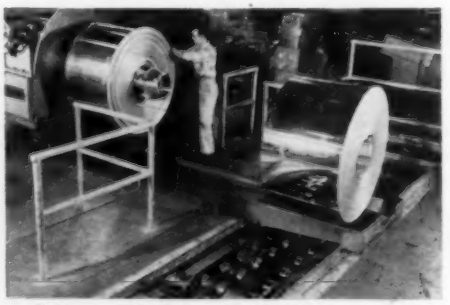
In mills all over the country, Link-Belt conveying systems eliminate hours of lost time. Coils travel close together. They're handled gently, preventing edge damage. Down-time is reduced. Auxiliary devices transfer coils from one conveyor to another—turn, lower, tilt and weigh them with ease and precision. This increased mechanization means greater safety, reduced physical work for crews.

It pays to call in Link-Belt while expansion is still in the planning stage. The Link-Belt engineer—working with your own engineers, consultants and builders of mill and process equipment—can help you select the right conveying system for your exact needs.

13,282



At entry end of temper mill, coils are handled on 49 ft. Link-Belt Conveyor.

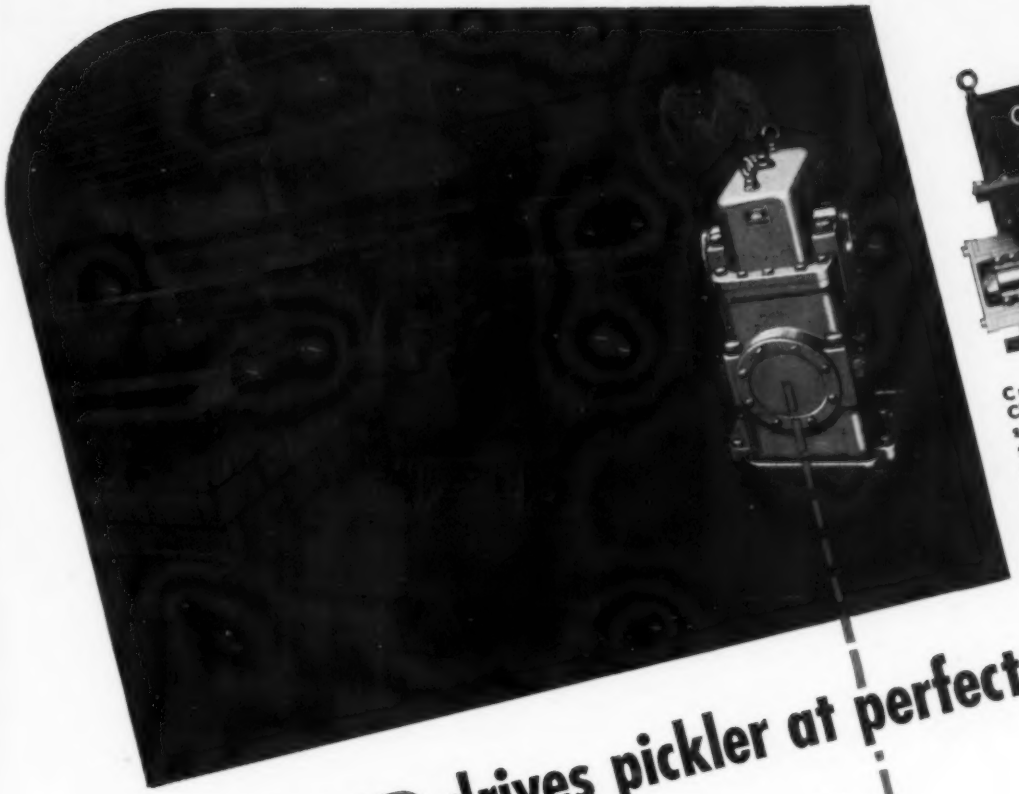


Coils are lifted from Link-Belt conveyor to pay-off reel by hydraulic buggy.

LINK-BELT

MATERIALS HANDLING, PROCESSING and POWER TRANSMISSION MACHINERY

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Scarboro, Ont. (Canada), Toronto (Canada), Elmira, Ont. (Canada), Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities.



Cutaway above—standard Cleveland Double Reduction Unit, showing high speed and low speed gear assemblies. Cleveland double reduction units available in special designs engineered to serve other slow speed needs. Left—courtesy Precision Drawn Steel Co., Camden, N. J.

CLEVELAND drives pickler at perfect pickling pace

SATISFACTORY pickling of steel requires a drive that immerses and raises bars at a prescribed slow rate. Uniformity of movement keeps the solution circulating evenly and insures efficient descaling.

Steel treated in the mechanical bar pickler shown above is neither underpickled nor overpickled. Installed in a New Jersey plant, it is driven by a dependable Cleveland double worm gear speed reducer. This Cleveland standard unit, incorporating both high speed and low speed gearing, provides a high reduction ratio in very limited space.

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Write today for new Catalog 400 with sizes, dimensions and horsepower ratings of the entire Cleveland line of worm gear drives. The Cleveland Worm & Gear Company, 3278 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

CLEVELAND
Worm Gear
Speed Reducers

HERE'S WHAT CAN HAPPEN when you overload your control equipment beyond its maximum interrupting capacity. Luckily this was a test under regulated conditions . . . but this (inset) is what could happen to your equipment with inadequate interrupting capacity in your control.

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interrupting capacity up to 250,000 kva

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